

# EXHIBIT 2

In re  
Walters, et al v. Flint, et al  
v.  
VNA and LAN  
17-cv-10164  
Report of Dr. Larry L. Russell  
January 3<sup>rd</sup>, 2023

Expert Report of Dr. Larry L. Russell  
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## 1 Scope of Engagement

My firm, REED International Ltd, has been retained by the law firm Levy Konigsberg, LLP, to assist them with the evaluation of the water quality failures that lead to the Flint Water Crisis. This work product will focus primarily on the role of the engineering services firms Lockwood Andrews and Newnam (LAN) and Veolia North America (Veolia) during the Flint Water Crisis.

## 2 Expert Qualification

My name is Dr. Larry L. Russell, P.E. I have been retained by Plaintiffs in the Flint Water Crisis litigation. I am an expert in water quality assessments, corrosion mitigation, and the behavior of materials exposed to drinking water. I earned a BS, a MS, and a Ph.D. from the University of California at Berkeley in Civil/Environmental Engineering. I am registered Professional Engineer in the State of Michigan and in approximately 30 other states. I am registered as a Civil, Chemical, and Corrosion Engineer in the State of California. I am a licensed water treatment operator in California (T3), Hawaii, Texas, and Nevada, and a licensed distribution operator in California (D3). I am also a licensed contractor in California, holding the following classifications: A Engineering, B Building, C-10 Electrical, C-36 Plumbing, C-55 Water Conditioning, HAZ (hazardous substance removal), and ABS (asbestos).

I have in excess of 40 years of experience in water quality assessments, corrosion evaluation, and materials performance evaluations. I have been an elected director of the Marin Municipal Water District (MMWD) since 2004. MMWD is a water district that serves 190,000 people.

Based on my 40 years of experience in the industry, I am familiar with the standards of care applicable to professional engineers in the water field. I have previously testified as an expert as to whether engineers have satisfied the applicable standard of care.

My initial education in engineering ethics began at a mandatory class in engineering ethics at the University of California at Berkeley in 1970. My education in ethics has continued since then for both my elected position wherein I am required by California law to take recurring ethics training every two years and for my renewal of my engineering registrations in states such as Florida, New Mexico, Texas and others wherein I attend or enroll in mandatory engineering ethics participation seminars or courses as the case may be. As a result, my ethics training is reinforced in a systematic and uniform manner

To prepare this report, I completed the following actions: I have reviewed the documents listed in the Materials Reviewed section. Reviewed documents include those prepared by Veolia, LAN, the Environmental Protection Agency (EPA), the Michigan Department of Environmental Quality (MDEQ), as well as published articles, documents associated with experts for the defense, and trial and deposition testimony of witnesses involved in the water quality issues experienced during the Flint Water Crisis.

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### 3 Opinions

- 1 LAN and Veolia should have been aware of, absorbed, understood and heeded the advice, information and warnings contained in the Tucker, Young, Jackson, Tull, Inc. (TYJT)/CH2M Hill, Inc./Economic and Engineering Services Inc. comprehensive study and report conducted in the early 1990's for the DWSD. This report was conducted to ensure that the DWSD water was safe to drink and was in compliance with the Lead and Copper Rule requirements of the Safe Drinking Water Act (SDWA) (Flint was considered to be within the DWSD distribution system) and the guidance presented in the TYJT report should have been followed by LAN and Veolia.

Basis: Detailed technical evaluation of the TYJT report and review of the DWSD Consumer Confidence Reports and Section 7 of this report

- 2 Both the LAN proposal that claimed the lime soda process was a corrosion control practice, and the Veolia proposal to utilize polyphosphates for aesthetic water quality improvement, were clearly and thoroughly debunked years earlier in the TYJT 1994 report, and to promote either of these ideas was a violation of the standard of care.

Basis: Review of Section 6 of this report and knowledge of corrosion chemistry

- 3 If LAN and Veolia had insisted on the addition of orthophosphate based on their observations and the TYJT report, as part of their retention by and work for the City of Flint, the impact of the accelerated corrosion on the lead levels in the Flint drinking water would have been substantially reduced.

Basis: Knowledge of the water chemistry and corrosive nature of the Flint River Water, both treated and untreated.

- 4 Veolia was treating their initial retention as "paid due diligence" for a desired larger project, involving the installation of six Veolia managers to direct the City water treatment staff and for which Veolia submitted an unsolicited proposal on March 25<sup>th</sup> 2015.

Basis: Veolia proposal dated March 25<sup>th</sup> 2015 and internal communications

- 5 Based on Veolia's reputation, style, expertise in water quality (and their own self-interests), Veolia knew of and effectively ignored the problems in Flint associated with water treatment, water chemistry, corrosion, distribution, understaffing, inept staffing, and inadequate training before they submitted the only response to be received to the nationally circulated Request for Proposals ("RFP") soliciting an independent water quality expert in January 2015.

Basis: City of Flint records and Veolia internal communications

- 6 Veolia was singularly focused on increasing its income from the City of Flint, rather than on improving water quality for and protecting the health, safety and general welfare of the citizens of Flint.

Basis: Numerous internal Veolia emails and memos as documented in this report

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7 The lead levels remaining in the heavily corroded and tuberculated steel pipe sections collected from a house in Flint (and most likely at all other similarly plumbed homes having water service laterals made from lead) are excessive and present a risk to the health of the residents of Flint and require removal to protect the health of the citizens of Flint. Additionally, the current standards for lead content for drinking water fixtures are up to two orders of magnitude lower than the lead content of the installed fixtures and will likewise require removal and updating with fixtures that meet the current less than 0.25 percent lead requirement. The condition of the residual scale that remains in the pipes today, with the high lead content, is a problem that needs to be corrected immediately.

Basis: Measurements and observations reported in the Russell Supplement Report submitted on October 18, 2022

8 Veolia's involvement provided the last clear chance for the citizens of Flint to be spared exposure to more high lead content drinking water and Veolia dropped the ball due to conflicts of interest and multiple failures to meet the standard of care.

Basis: Knowledge of corrosion chemistry and timing of Veolia's retention

9 LAN, Veolia, and their respective engineers practiced below the standard of care with respect to water quality engineering during the time of their work in Flint.

Basis: The Flint Water Crisis continued unabated during Veolia's tenure

10 LAN, Veolia, and their respective engineers violated the standard of care and the code of ethics for engineers by putting their profits before the health and safety of the citizens of Flint.

Basis: Numerous internal Veolia emails and memos as documented in this report. LAN engineers and other witness testimony

11 LAN and Veolia engineers intentionally understated the health risk from lead to the citizens of Flint in their reports and presentations, which is below the standard of care.

Basis: Review of their reports and the trial and deposition testimony

12 Veolia and its engineers omitted reporting on lead and copper results from their presentations and reports, which is below the standard of care.

Basis: Review of their reports and the trial and deposition testimony

13 Veolia allowed their non-technical, business development personnel, to direct the technical work in Flint, which is below the standard of care for engineers.

Basis: Veolia email presented on page 39 of this report

14 Clearly, LAN, Veolia and their respective engineers failed to meet their ethical obligations along the path that led to and perpetuated the Flint Water Crisis, by failing to make independent statements to the regulatory authorities of their concerns for the health, welfare and safety of the citizens of Flint due to the poor water quality they were receiving.

Basis: NSPE case 20-04 and the NSPE code of ethics as adopted by the State of Michigan in September 2021 (exhibit 5012 of Trial 1)

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- 15 Veolia should have presented reconnecting to the DWSD system as the recommended option in their presentations and their reports made to the City and to the public. In affirmatively choosing not to do so, Veolia violated three of the engineering standard of care requirements (NSPE), as well as not disclosing their economic conflict of interest based on their March 25<sup>th</sup>, 2015 unsolicited proposal to the City of Flint to take over water operations.

Basis: NSPE code of ethics adopted by the State of Michigan in September 2021 and the Veolia proposal dated 3/25/2015 (VEOLIA 324151)

- 16 LAN should have included remaining connected to the DWSD system as an option.

Basis: NSPE code of ethics adopted by the State of Michigan in September 2021 and the 2013 LAN proposal to the City of Flint.

- 17 The TYJT team also indicated that the cost of dosing with phosphoric acid added an operating cost of \$0.87 annually per household in 1994 USD (\$1.50 in 2014 USD).

Basis: TYJT report and CPI inflation records

- 18 The wild variations in pH and alkalinity experienced at the Flint Water Plant, and the lack of direction by LAN and Veolia to address the lead contamination issues in Flint were the root causes of the Flint Water Crisis.

Basis: Knowledge of water treatment and corrosion control

- 19 LAN's and Veolia's actions were a direct cause of the loss of trust in the Flint water supply and the need for supplying bottled drinking water to the citizens of Flint.

Basis: Knowledge of water treatment and corrosion control

- 20 Both LAN and Veolia were the only water quality experts available to the City of Flint and both failed to meet the needs of the City of Flint due to their failure to meet the standard of care.

Basis: Knowledge of the work product produced by LAN and Veolia and the situation at Flint.

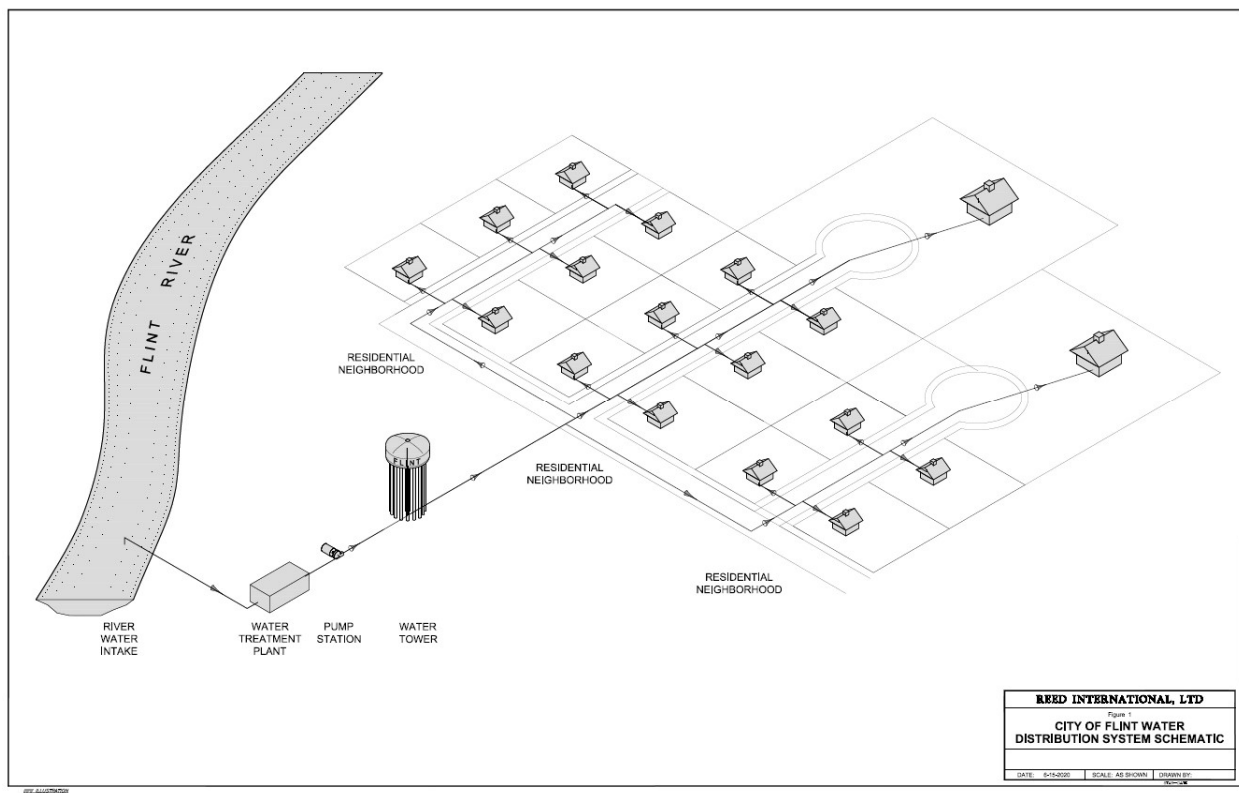
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## 4 Historical Background

### 4.1 Water Distribution Systems

Typically, water distribution systems are built similar in structure to a tree. The water mains are the large diameter pipes that distribute water throughout the city and resemble the trunk and major branches on a tree. Each house is connected via a service lateral to the water mains to receive water. The houses have internal piping supplying water to each fixture, which resembles leaves. Figure 5.1.B below shows a schematic of the Flint water system illustrating the tree like nature of a water distribution system. All homes and businesses receive the same water as there is only one connection into the distribution system.

*Figure 4.1-A: Schematic figure of the distribution system in Flint, Michigan. Note that there is only one source of water, and all properties served by the distributions system received the same water.*



A variety of piping materials are used to convey water in the mains. Most water systems in the US have main distribution pipes that are constructed of ductile iron, cast iron, asbestos cement, mortar lined pipe, or PVC. For water pipes, the use of cast iron pipes dates back to Europe in the 1300's and galvanized steel back to the 1940's. Ductile iron piping dates back to 1955 and dominated the US market for water mains by the 1970's.

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The water mains are connected to individual users' systems by service laterals. Lead laterals were commonly used in the Midwest/Northeastern United States until the 1950's when installations ceased. Indeed, lead service laterals were required by an 1897 ordinance in Flint. The usage of lead pig tails for joining cast iron continued until they were prohibited in 1988 by the Lead Contamination Control Act. The laterals in Flint Michigan were constructed of a mix of lead pipe, galvanized steel pipe, and copper pipe depending upon how long ago they were installed. The negative impacts of lead water poisoning have been well known since the time of the Romans, yet lead containing components are present in many water systems across the US today.

Piping inside of structures is commonly made from lead, copper, galvanized steel, or plastic. Therefore, not only would metal have suffered from the impacts of corrosion outside of the homes, the metal pipes would also have suffered from corrosion inside of the homes.

In the US, galvanized piping became common after World War II and is the most common piping within buildings across the world. Copper piping has been displacing galvanized piping in the United States for household plumbing since the 1960's. More recently both plastic piping (PVC, PEX) and copper are common. Each of these types of pipes (with the exception of plastic) is susceptible to corrosion and the potential release of metals from the piping material (hence the reason for the terminology: "Lead and Copper Rule" [LCR]). The drinking water chemistry must be managed to maintain the life of metallic pipes and fixtures, to limit or prevent corrosion, and to prevent the release of metals into the drinking water.

## 4.2 The City of Flint and its Water Distribution System

The first water distribution system in Flint was privately owned and was called the Flint Water Works Company. That company was incorporated in 1883. In 1897, the City of Flint passed an ordinance requiring the use of lead laterals (Masten 2016). The City of Flint purchased the Flint Water Company in 1912.

The Flint Water Treatment Plant (FWTP) was originally constructed in 1917. Flint River water was treated at the FWTP and served as the source of water for the City of Flint until 1967. From the 1930's, until 1967, the water from the Flint River was treated using alum coagulation, sand filtration, and chlorination as a disinfectant. The 1917 plant was rated to treat 28 million gallons per day (mgd). Construction of a new treatment plant for the City of Flint was completed in 1954. At that time the treatment system consisted of pre-chlorination, coagulation with alum, lime-soda ash softening, re-carbonation, filtration, and addition of polyphosphate. The treatment plant was rated for 59 mgd with a maximum capacity of 86 mgd.

Flint's population peaked and exceeded 200,000 in the 1960's (Davis et al. 2016), driving the need for additional water supply sources. To expand its water supply, the City of Flint began purchasing treated water from Detroit Water and Sewage Department (DWSD) in 1967, and at that time converted the FWTP into a standby operation. The primary purpose for the switch over to the DWSD was to ensure that there was sufficient water for the growing population of the City of Flint and its seven General Motors plants, and to improve treated water quality. The water provided by DWSD was treated lake water from Lake Huron.

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Following the switch to DWSD water in 1967, the City of Flint water treatment system, known as the Flint Water Service Center (FWSC), was maintained as a backup water treatment facility. The FWSC system was put into service a few days a year, however, the treated water was not blended into the distribution, but was instead returned back into the Flint River under a National Pollution Discharge Elimination System (NPDES) permit.

By 2014, the population of the City had declined to less than 100,000 people, with a 20 percent drop occurring since 2000. Accordingly, water demand in the City decreased due to the reduced population and reduced industrial needs.

DWSD implemented modern corrosion control via orthophosphate in their water starting in 1996, based on a detailed Optimal Corrosion Control study undertaken by Tucker, Young, Jackson, (TYJT) in 1994. Corrosion control studies were performed on the DWSD water by the TYJT team in the 1990's, which included "a desktop study, a pipe loop study, and pilot distribution system testing, including water quality parameter testing" (GLWA, 2016). Those corrosion control studies were used to determine the required properties of the treated water to minimize corrosion, which included establishing a minimum orthophosphate dose of 0.9 mg/L (GLWA, 2016). At the time of the 2014 switchover from DWSD to Flint River water, the distribution systems in Flint had been receiving water with optimized corrosion control (pH control and orthophosphate addition) for almost two decades.

The use of orthophosphates by the DWSD in 1996 and continuing for eighteen years, through 2014 before the switch to the Flint River, provided a protective coating or scale in the entire system.

An assessment of the Flint River performed by the Michigan Department of Natural Resources in 2001 identified that the Flint River had substantial chlorides present. Sources providing chlorides to the river included discharges from industry (regulated and unregulated) and roadway runoff (i.e. road salting) (Leonardi and Gruhn, 2001). The high chloride concentrations in the Flint River resulted from a variety of sources including storage in Holloway Reservoir (evaporation and concentration), industrial and agricultural discharges, and runoff of salt used in wintertime road deicing. These conditions were well known prior to the switch to the Flint River in 2014 (USGS 1963). The concentrations of chlorides in the distributed water were further increased 25 to 100 percent by the use of ferric chloride, as a coagulant at the water treatment plant (Masten 2016). The coagulant choice and dosing rates are critical water system design/operational parameters, that should have been corrected by Veolia as part of its work.

The high concentrations of chloride in the water, combined with the low concentrations of sulfate, resulted in high values on the well-known corrosion index, the Chloride-Sulfate Mass Ratio (CSMR). The CSMR values, which should have been identified before the switch to the Flint River water in 2014 and which Veolia should have identified later (in February 2015), put the system at corrosion risk categories of *significant concern* to *serious concern* (Masten 2016). In fact, Veolia knew that "corrosive water conditions" existed, based on other analyses conducted. The data required to perform the CSMR calculation was readily available to the engineers of Veolia, consisting of commonly measured water quality parameters. The highly corrosive water was present throughout the entire distribution system as there was only one water source supplying the City of Flint. Contact with this water compromised the integrity of the protective coating and scale lining the pipes, and increased lead solubility in the Flint drinking water.

The corrosivity of the Flint River water was further exacerbated when the Veolia engineers failed to recommend or take steps to utilize any form of corrosion control, such as, orthophosphate addition. Inexplicably, the internal recommendation of its own engineer (Depin Chen) to add orthophosphate was disregarded by those in charge. Due to Veolia's failure to make these recommendations, the City continued providing water without any form of corrosion control, which caused continued degradation of

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the existing lead phosphate scales. No corrosion control was provided during the entire period of operation using the Flint River water as its source. Making matters worse, Veolia recommended increasing the dosing of ferric chloride, which would have resulted in increasing the CSMR, making the water even more corrosive to lead. Rather, if Veolia had recommended that Flint stop adding ferric chloride, lead corrosion would have decreased.

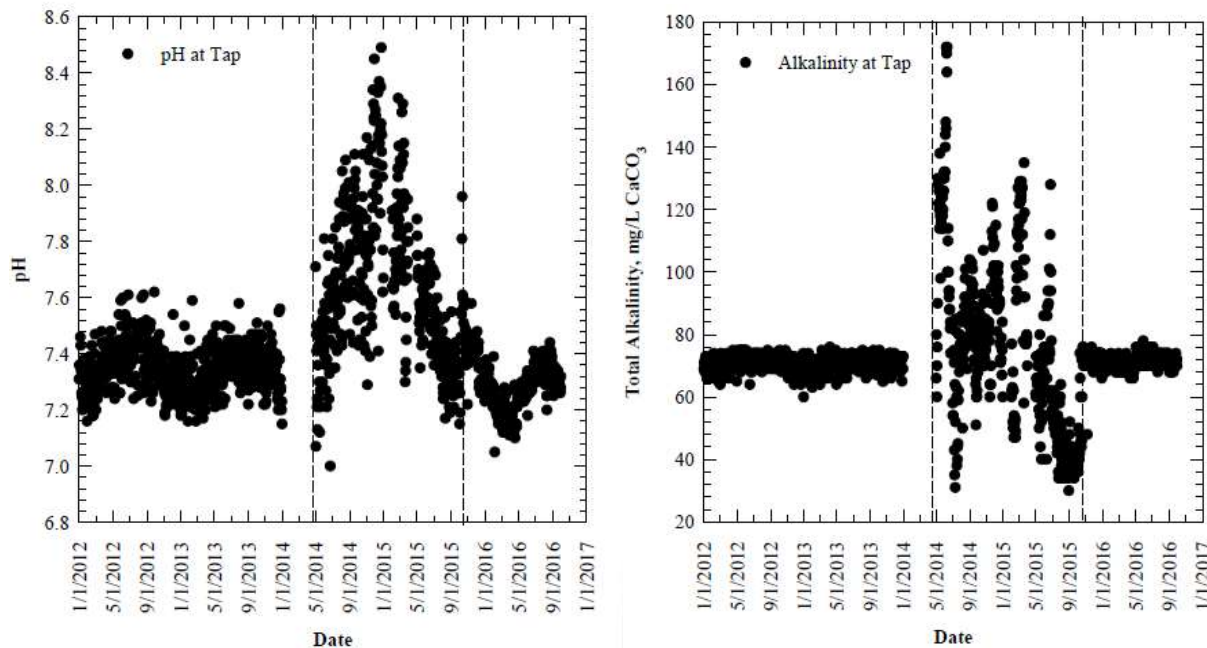
The corrosive water provided from the Flint River increased the effective steel corrosion rate by upwards of an order of magnitude (10 times more) when compared with the DWSD water that was provided to Flint prior to the switch in 2014 (Edwards 2015). This increased corrosivity was obvious given the magnitude the increase in chlorides in a low alkalinity water (as was present after softening of the Flint River water) and the excessive red water (iron corrosion) reports throughout the City of Flint. Veolia was aware of both as undoubtedly was LAN.

When alum was in use to treat Flint River water in the 1950's and 60's, the CSMR was 0.35 (see Section 7, USGS 1963), whereas the CSMR increased to between 2.8 and 3.8 during the Flint Water Crisis. Thus, had either LAN and/or Veolia simply recommended that Flint switch back to alum, as was used as a coagulant for nearly 50 years prior to 1967, the CSMR would have decreased from 3.8 to 0.35, which would have resulted in a substantial reduction in the rate of iron and lead corrosion. Today the CSMR in Flint, which is again supplied with DWSD water, is approximately 0.5 (or less) with an alkalinity of 75 mg/l as CaCO<sub>3</sub> (DWSD 2021, Consumer Confidence Report). The DWSD is sourced from Lake Huron, which is naturally less corrosive than the water in the Flint River. None the less, the DWSD water is treated for corrosion control with orthophosphate (the dosage of which is now further increased by the City of Flint).

One of the essential aspects of controlling corrosion in water systems is providing stable water chemistry conditions. The water in the distribution system attempts to establish equilibrium with the various plumbing components and particularly the surface scales. Consequently, stable conditions help establish the formation of scales while rapidly changing or variable conditions tend to destroy the protective scales. During the Flint Water Crisis, and specifically during Veolia's work for Flint, the Flint water distribution system demonstrated highly variable conditions for two critical water quality parameters, pH and alkalinity. This variability during the Flint Water crisis as compared to the periods of operation on DWSD water is shown in Figures 4.2.A and 4.2.B below.

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*Figures 4.2.A and 4.2.B: pH (left) and alkalinity (right) are of the treated water supplied in Flint from 2012-2017. The vertical dashed lines show the period the system was supplied with Flint River water from approximately May 2014-October 2015. Note the dramatic variability in both parameters during operation on the Flint River water as compared with the DWSD periods (January 2012-May 2014 and October 2015-October 2016). As can be seen in the plot on the right, alkalinity was variable and was at low levels for multiple periods during operation on the Flint River water.*



Such excessive variability is known to cause the destabilization of phosphate scales which releases lead into the water when they dissolve and can increase the corrosion rates. Dr. Gagnon commented on his concerns about variability during the first trial. These fluctuations can greatly accelerate corrosion, can be a driving factor in the progression of pinhole leaks in steel, overall degradation of copper pipe, and can cause lead scale detachment, solubilization, and migration. In February of 2015, Veolia knew of this variability and fluctuation from the Monthly Operating Reports (MORs) that it was provided with. Yet, this issue was not addressed by them in any of their reports to the City of Flint.

The Veolia engineering consultants clearly failed to provide the City with the direction to implement the required corrosion control strategies. As a result, the City of Flint continued to be subjected to corrosive water that damaged plumbing systems and exposed the residents to high concentrations of lead. Much (if not all) of these problems could have been avoided by implementation of proper corrosion control.

It is clear that the water quality remained highly variable while Veolia was retained in Flint and remained so thereafter. Despite Veolia being only physically present onsite for a few weeks there was a continuation of the same wild variability which indicate poor process control and poor operational control at the Flint Water Treatment plant that had been experienced before Veolia began their tenure.

During 2005-2011 LCR sampling, while the City of Flint operated on DWSD water, the distribution system in Flint consistently reported lead sample results that were below the Action Level as specified in the Lead and Copper Rule (LCR). In fact, during the three LCR sampling events which occurred (2005, 2008, 2011) Flint's lead and copper sampling failed to locate a single home in the City that had lead concentrations in excess of the 15 µg/L action level. Further, the LCR lead sampling in 2008 and 2011 did not detect a single sample above the detection limit reported (2 µg/L) (EGLE0002604).

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On June 24, 2015, the U.S. EPA indeed concluded that “galvanic corrosion” had increased as a result of the chloride in the Flint River water and the City’s continued use of ferric chloride (Del Toral 2015, emphasis added):

*In addition, following the switch to using the Flint River, the City of Flint began adding ferric chloride, a coagulant used to improve the removal of organic matter, as part of the strategy to reduce the TTHM levels. Studies have shown that an increase in the **chloride-to-sulfate** mass ratio in the water can adversely affect lead levels by **increasing the galvanic corrosion of lead in the plumbing network.***

In August 2015, detectible levels of lead were found in 85 percent of the first draw samples collected from residences. The comprehensive sampling performed by the sampling team found that Flint’s housing actually had water samples with a 90<sup>th</sup> percentile lead concentration of 26.6 µg/L, over 75 percent above the regulated action level (Pieper et al. 2017; Pieper et al. 2018).

Extensive lead contamination was identified in the water at a Flint residence by the Virginia Tech team during the Flint Water Crisis. They performed comprehensive testing during the Flint Water Crisis and identified lead concentrations as high as 13,200 µg/L at the tap. That concentration is 880 times higher than the action level defined in the LCR regulations (Pieper et al. 2017). In fact, one eighth of Virginia Tech samples from the test sites contained lead concentrations in the drinking water that exceeded the EPA threshold for hazardous waste of 5000 µg/L (Pieper et al. 2017) indicating a serious concern for anyone who consumed that water.

The Flint River presents a number of challenges with regard to treatment and corrosion control. Evidence for these challenges dates back to at least the 1950’s when the City previously operated on the Flint River. During that period polyphosphates were added to the water (Masten, 2016; USGS 1963). Polyphosphates were characterized as corrosion-control, but are indeed used solely to mitigate the aesthetic impacts resulting from corrosion in iron-based water distribution systems (i.e., red water), they do not control or limit lead corrosion. In fact, the use of polyphosphate can increase corrosion. An assessment of the Flint River performed by the Michigan Department of Natural Resources in 2001 identified that the Flint River had chlorides present. Sources providing chlorides to the river included discharges from industry (regulated and unregulated) and roadway runoff (i.e., road salting) (Leonardi and Gruhn, 2001). Yet in 2015 Veolia recommended the use of polyphosphates to mask the effects of red water in the City of Flint drinking water, while not addressing the real issue, which was excessive lead in the water and corrosion of the piping materials.

Also, as highlighted in the 2002 treatability study on the Flint River water that was performed by AB&H, the water had a number of challenging properties that made the Flint River water more difficult to treat. Examples of those challenges included high and seasonally variable hardness, high organic matter concentrations, and high disinfection byproduct formation potential (AB&H 2002). A 1998 report by the Snell Environmental Group (SEG) evaluated the modifications and upgrades that were needed at the Flint Water Treatment Plant to treat Flint River Water (SEG 1998).

Most of the issues identified by SEG in 1998, remained when the plant was placed into fulltime service on Flint River water in 2014. The SEG report identified the need for phosphate-based corrosion control equipment, concluding that equipment to provide a 1-2 mg/L dosing of PO<sub>4</sub> (SEG 1998 p. 3-12) and a chloramine dosing system to supply a residual disinfectant for the distribution system (SEG 1998 p. 3-16) was required. I fully concur with the SEG 1998 recommendations.

The Flint River was a challenging water source to treat, and was known to have corrosion issues dating back at least to its use in 1950’s. A simple reading of the existing reports and a desktop analysis of the

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corrosiveness of the Flint River water would have indicated that there were high risks for lead corrosion when using the treated Flint River water as the Flint water supply. These issues should have been identified and addressed via a corrosion control study prior to the change over to the Flint River. In all events, they should have also been addressed when Veolia worked on the Flint water quality issues in 2015.

LAN provided consulting and engineering management services since the work of AB&H (which was acquired by LAN) in the early 2000's. It is clear that LAN engineers never had a real sense or understanding of what would be required to make the Flint water plant able to provide reliable water treatment on the Flint River water. The evidence of this was the fact that the General Motors engine plant in Flint was unable to build engines with the treated Flint River water, and they demanded and received a return to the DWSD water at a cost of over \$440,000 to the City of Flint in late 2014. LAN clearly practiced below the standard of care during their tenure at Flint. In-fact, at one point, in a draft report, a LAN engineer included the addition of a phosphate feed system for the Flint Water Treatment Plant, which somehow found its way out of that particular final report (LAN FLINT 00205699, Case No. 17-10164 Trial Testimony: March 2<sup>nd</sup>, 2022, p. 459).

Veolia and its engineers and operators were the last hope to halt the Flint Water Crisis, but Veolia dropped the ball and likely enhanced and made worse what was occurring. Based on testimony of Veolia engineers and managers involved with Flint, Veolia was well aware in February of 2015, that the best and safest solution to the Flint Water Crisis, which was to return to the Detroit Water and Sewage Department (DWSD) (Great Lakes Water Authority (GLWA)) for their water supply. Such a recommendation was never included in any Veolia report to the City of Flint, and Emergency Manager Ambrose was against this option based on his mistaken belief that the Flint River sourced water was "just as safe" as what the City had previously received from the DWSD. Ultimately, this was exactly the solution that was used in Flint when it was revealed that water was not safe.

Clearly, it was not the value of Veolia's \$40,000 contract that was driving Veolia's interests, but rather a much bigger potential project. In an email sent by Mr. Rob Nicholas on February 2, 2015, he stated that Veolia should consider the \$40,000 contract as "paid due diligence" for their larger operational contract goal. The Great Lakes Water Authority (GLWA) was formed in 2014 to provide a home for the debt incurred by the Detroit Water and Sewage Department (DWSD) and to operate the DWSD assets outside of the City of Detroit as a result of the City of Detroit's bankruptcy. Veolia was retained by the City of Detroit to assist them with managing their utilities during the bankruptcy. During that retention, Veolia petitioned the City of Detroit for Veolia to take over the operations of the water and wastewater under an operations contract, but that proposal was rebuffed.

Veolia then switched gears to pursue the City of Flint under a similar water operations contract, as evidenced by Veolia's response to Flint's RFP in January 2015. Later Veolia submitted a proposal on March 25<sup>th</sup>, 2015 to the City of Flint, offering to provide what Veolia called "Delegated Management" for a fee of \$1,827,000 per year. This contract appeared to be the driving force behind Veolia's willingness to compromise their ethical obligations to protect the health and welfare of the citizens of Flint, while conducting an unusual (for Veolia) consulting contract for Flint. It is clear that switching Flint back to DWSD water would compromise Veolia's plan to take over operations in Flint, as Flint would merely be a retailer of the DWSD water without the need for an operated water treatment plant in Flint or the Veolia personnel. Thus, Veolia potentially would benefit from recommending that the City of Flint either continuing to treat the Flint River Water or to treat the raw Karegnondi Water Authority (KWA) water, if they were successful in getting the operations contract from Flint. Conversely, if Veolia recommended a return to the DWSD, and Flint followed that recommendation, there would have been no future work for

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Veolia (as the DWSD/GLWA had already rebuffed Veolia's attempts to take over the operations of the DWSD system).

Clearly there are at least two conflicts of interest in their March 25<sup>th</sup> proposal. The first conflict of interest is that Veolia is working for DWSD/GLWA at the time of the March 25<sup>th</sup> proposal, and they should ethically be supporting returning Flint to DWSD/GLWA as their water supply, as Flint represented approximately 15 percent of the DWSD/GLWA income. Instead, in their March 25<sup>th</sup> proposal they are promoting cost savings to Flint of using the KWA water (Lake Huron water – same source as DWSD), but (of course) under Veolia management. Clearly the intent of the Veolia March 25<sup>th</sup> proposal is to maximize the income to Veolia by keeping the Flint Water treatment plant running with Veolia in charge. The second conflict of interest involves the City of Flint. In the Veolia March 25<sup>th</sup> proposal, there is no mention of returning to the treated water from the DWSD/GLWA water wherein Flint would once again become a water retailer with no need for the \$1.8 million annual Veolia management fee. Once again, Veolia has ignored their engineering ethics responsibility to protect the health, safety and welfare (and pocket-books) of City and the residents of Flint over and above their own financial interests.

The Veolia engineers Mr. Marvin Gnagy and Mr. Depin Chen understood that the first responsibility as an engineer is to serve the health and welfare of the public, not their employer or their client. However, both allowed themselves to be cowed into doing exactly the opposite of what they knew was their ethical responsibility to the public, Mr. Gnagy claims that when he suggested the possibility of returning to the DWSD (albeit when Veolia was telling Emergency Manager Ambrose and the City of Flint that their water was "safe") Mr. Ambrose told him that "if you want to get paid stick to your scope."

If this is actually occurred, which seems doubtful, it makes absolutely no sense why Veolia would have heeded Mr. Ambrose's warning, insofar as Veolia reported earnings on March 31<sup>st</sup> of 2022 of USD \$9.935 billion, and a profit of \$1.456 billion USD, which corresponded to Veolia grossing approximately \$19,000 per minute on a 365-day, 24-hour basis. Or stated differently - every two minutes the Veolia corporation earns the value of the Flint contract.

In any event, ethically, Veolia should not have allowed money to compromise their responsibility to protect the health, safety and welfare of the public regardless of the amount involved (which is a clear violation of the ASCE, NSPE and Michigan PE code of ethics); however, Veolia made the corporate decision to compromise, even though they knew full well that acute health issues like lead and Legionella were far more serious and demanding of immediate action than a chronic health concern like disinfection byproducts (which may express themselves with an excess cancer after 70 years of continuous water consumption). Veolia had the ethical obligation to help the citizens of Flint to avoid further damage to their health, safety, welfare, and property. Based on their time spent at the treatment plant, meetings with plant staff and in particular Mr. Mike Glasgow (Chief Water Operator), Veolia was aware of the limitations of the Flint water treatment staff and the water treatment plant (this knowledge is also as evidenced by the Veolia March 25<sup>th</sup> proposal indicating that Veolia was aware of the need to provide water treatment management services to Flint water plant operations). Indeed, Glasgow himself acknowledged that the Flint Water Treatment Plant wasn't ready to operate effectively, and he knew his operators weren't adequately trained to do the lime-soda treatment of the Flint River water, which was the only pH and alkalinity control implemented.

There were significant shortcomings in the design work on the Flint River Water Treatment Plant by Lockwood, Andrews and Newnan (LAN). Why didn't the experienced engineering team from Veolia focus on a plan to address the deep technical hole left by those shortcomings? The answer is as clear as it is simple – Veolia knew the correct and obvious answer, which was to return to the DWSD treated and

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provide corrosion inhibited water immediately, but they chose to withhold this information from the public for their own pecuniary gain. The position to switch back to DWSD was espoused by both Mr. Chen and Mr. Fahey; however, Veolia ultimately allowed the LAN position to become their engineering standard of care, which was to allow the deficient Flint water treatment plant to be pressed into service where amongst a laundry list of many missing items was the computer management system (SCADA), which is the one single system required to be able to operate the plant successfully and the SCADA wasn't operable and wouldn't be operable for months after the switch over the Flint River water was made. The results of allowing the plant to operate without the required SCADA system is clearly seen in Figures 5.2 A and B, which show a very large degree of variability in the water plant effluent pH and alkalinity, which are directly caused by a lack of operator knowledge and the lack of SCADA. The Veolia position was below the standard of care for engineers.

As soon as it was engaged by the City of Flint, Veolia should have begun actions to prepare recommendations to address and correct the shortcomings of LAN's engineering advice and to address the LAN mistakes. Instead, Veolia chose to duck and cover and avoid the objections from Mr. Ambrose. The engineering ethics rules were developed to protect engineers, and to address the exact situation that Veolia was caught in. Clearly, Veolia entered into this work with a crystal-clear understanding that the only way out of the Flint Water Crisis was for Veolia to stand up and correct the LAN errors of the past, by insisting on switching back to the DWSD water; and providing corrosion inhibited water immediately. However, Veolia failed to do what was required. As a result, the self-serving actions of Veolia were below their requisite standard of care.

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## 5 What Veolia Likely Knew Before Starting in Flint

Veolia was very familiar with the situation that they encountered in Flint. First, they had been working in the City of Detroit since at least 2014, when Flint used nearly 15 percent of the DWSD's water production. Through that work, Veolia was well aware that DWSD was relying on the use of orthophosphate to provide corrosion control, and had been doing so since 1996, when the results of the 1994 TYJT study were enacted. Second, Veolia had been working in Pittsburg since 2012 on the same basic issues as Detroit and Flint, namely, the impact of lead service laterals, water that was corrosive to lead pipes and high lead containing fixtures, and high lead levels in their drinking water. Moreover, through that work, Veolia's engineer Marvin Gnagy admittedly learned of the EPA's public announcement "that any level of lead was dangerous in drinking water."

Based on their reputation, their style, and their proximity to Flint while working in Detroit, Veolia would have conducted basic due diligence prior to submitting their proposal for the initial project. Veolia would have researched the specifics of Flint's situation, met with City personnel, evaluated the impact of switching water sources and the local politics. In addition, it is likely that Veolia was fully aware of the consequences to the DWSD of Flint's disconnection from the DWSD, due to their work for the DWSD, and of the potential impacts on water quality with the switch to the Flint River. Veolia's experience, and specifically their work in Pittsburg and Detroit, would have made them well aware of the potential for severe water quality issues in Flint. To that end, during the crisis and publicly, David Gadis, the Vice President of Veolia's Municipal and Commercial Business, stated: "[W]e understand the frustration and urgency in Flint," and that Veolia was "honored to support your community with our technical expertise so that together we can ensure water quality for the people of the city of Flint."

At the beginning of the \$40,000 project, Veolia conducted a tour of the Flint Water treatment plant, and as Mr. Rob Nicholas acknowledged, the initial Veolia contract should be viewed "as paid due diligence" for the larger project they desired to be awarded. Based on the recommendations made by the Veolia engineers, it is also clear that Veolia either intentionally ignored or never fully grasped the magnitude of what was happening regarding lead contamination due to corrosion in Flint, and based on the advice they gave to Flint, Veolia therefore practiced below the required standard of care.

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## 6 1994 DWSD Copper Corrosion Control Optimization Study

Veolia had been working for the DWSD since at least 2014, and LAN had been working in Flint since approximately 2000. LAN's primary Engineer in its work in Flint, Warren Green, had been performing work in Flint since the mid to late 1990s. Veolia's work in Detroit continued during the time of their engagement in Flint, and it is inconceivable that the Veolia and LAN engineers were not familiar with the Optimized Corrosion Control Treatment (OCCT) study conducted for the DWSD. In fact, Veolia water quality engineer Marvin Gnagy testified on December 12, 2019 (29:16 and 30:14) that he personally reviewed the DWSD corrosion control program on behalf of Veolia for their work at Detroit. The DWSD study was prepared by Tucker, Young, Jackson, Tull, Inc. (TYJT) in association with CH2M Hill, Inc. and Economic and Engineering Services Inc. in May of 1994 for DWSD (and presumably the contents of the TYJT corrosion control report). It is important to realize that the approach utilized by the TYJT team is a picture-perfect example of what is/was industry standard then and today (and an example of truly outstanding work for 1994).

In Gnagy's deposition (30:14) he incorrectly and inexplicably stated that the DWSD adjusts the pH and alkalinity to reduce corrosion and that they add orthophosphate, perhaps indicating that he did not really evaluate the DWSD OCCT program. In reality, the DWSD only adds orthophosphate, and does not adjust the alkalinity and pH except through a minimal lowering, due to the water treatment chemical addition as ferric chloride is a Lewis acid.

Most importantly, failure to follow the plan laid out by the TYJT team in 1994 lead to a fatal flaw in both LAN's and the Veolia's assessment of the problems in Flint. This flaw indicates the failure of both firms to meet the Standard of Care for the work that they performed before and/or during the Flint Water Crisis. The 1994 report was based on pipe loop studies, solid engineering evaluations, a true understanding of the corrosiveness of the treated Lake Huron water, appreciation of the number of lead service laterals, accurate knowledge of the EPA rules and regulations with respect to the Lead and Copper Rule, and water/corrosion chemistry in general, along with the TYJT guidelines and observations for implementing a successful and comprehensive Optimal Corrosion Control Treatment plan for Flint.

Clearly, the Lake Huron and Flint River water sources are substantially different (higher chlorides, etc. in the treated Flint River making it substantially more corrosive than treated Lake Huron water), which served to make the need for having an OCCT at Flint even more urgent than it was for DWSD. The DWSD report should have formed an obvious road map for the engineers at Veolia, as many of the issues faced in Detroit are similar to those in Flint (including lead service laterals, old plumbing systems, potentially corrosive water, and the Flint distribution system which is considered to be a part of the DWSD system). The Optimized Corrosion Control Program (OCCP) instituted by DWSD should have been the starting point for implementation of the corrosion control program for the treated Flint River water. However, neither LAN nor Veolia followed the TYJT path. If LAN and/or Veolia had followed the work begun by the TYJT team, the City of Flint would have progressed a long way, very quickly toward averting the Flint Water Crisis. The DWSD report would have made an excellent road map for both LAN and Veolia to guide their work for the City of Flint on water quality engineering, and it is likely that if LAN and Veolia professional engineering guidance had been molded with the full knowledge expressed in the 1994 DWSD report, that the impacts of the Flint Water Crisis would have been substantially lessened.

Based on the work conducted in the TYJT study, LAN's ongoing work in Flint, and Veolia's ongoing work in Detroit, it is inconceivable that LAN and/or Veolia would not have realized the value of adding

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orthophosphate to minimize corrosion of lead, copper, and iron to protect the health, safety, and welfare of the citizens of Flint as well as the plumbing systems in their homes and buildings. The need for orthophosphate is especially critical in light of Veolia's recommendation to increase the chloride in the water by adding more ferric chloride to reduce trihalomethane (THM) precursors, which would have made the treated Flint River water even more corrosive than it already was, had the City accepted Veolia's recommendation.

Similarly, it is equally inconceivable that the LAN engineers were not aware of the 1994 report, and which incorporated the City of Flint as a part of the DWSD distribution system as shown on Figure 6.1.1 (Figure ES -1 from the TYJT report). If both of the City's water quality engineering consultants were unaware of the TYJT OCCP study and report and the DWSD corrosion control program, then they did not adequately conduct their (paid) due diligence prior to providing advice to the City of Flint on water quality and it resulted in them both practicing below the requisite Standard of Care.

At the time the TYJT report was written, they indicated that the treated DWSD water was "moderately corrosive." (Pages ES 3 and ES 4 of the 1994 report). During two rounds of home water quality sampling conducted for that report in 1992, the lead results were 0.017 and 0.023 mg/l (see Figure 6.1.2 - both above the Lead Action Level of 0.015 mg/l). Thus, both rounds of sampling indicated that immediate action would be required to reduce the corrosiveness of the water to protect the plumbing and the user's health as required by the SDWA. While the copper numbers were better, they were not good. The resultant copper results were 0.34 and 0.19 mg/l (see Figure 6.1.3 - the Copper Action Level is 1.3 mg/l), indicating that there was active copper corrosion occurring within the houses in the DWSD distribution system.

The TYJT report correctly summarized the following about the various options for corrosion control treatment (note that in 1992, these first five options were eliminated from further consideration due to the factors listed below (page ES 5) [red emphasis added]):

- 1) "Polyphosphate – These products are primarily used to sequester iron, calcium and manganese and may actually do more to promote lead corrosion than to prevent it."
- 2) "Polyphosphate/Orthophosphate Blends – These products have not been proven to be more effective than orthophosphates alone for lead reduction, and their proprietary chemical compositions make selection of the optimum product difficult."
- 3) "Silicates – Sodium silicate inhibitors require a high dosage for lead control and, based on a survey of major industries, would have significant adverse effects on industrial water users."
- 4) "Alkalinity Adjustment - This technique would have marginal performance for lead reduction based on DWSD water quality and would be impractical for a system the size of DWSD."
- 5) "Calcium Adjustment to Deposit a Calcium Carbonate Layer – This technique is not a proven method for lead reduction, and would [sic] be difficult to produce a [sic] uniform layer throughout a distribution system the size of DWSD. Calcium carbonate deposition, however, can occur when pH is raised for lead reduction. This situation is addressed under pH adjustment alternative."
  - a. Note: Rejected Alternative (5) is lime softening – **championed** by LAN as the solution to controlling lead corrosion.

Note that the first item rejected for chemical addition for the Flint/DSWD system, Polyphosphate, was recommended by Veolia in 2015 (over 20 years after the TYJT rejected this chemical additional from further consideration), and items 4 and 5 of the rejected alternatives were the basis of the LAN ill-fated

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recommendations for using water softening as a corrosion control alternative for the Flint River water. Had LAN and Veolia simply promoted the approach utilized by TYJT in the 1990's, it is likely that the Flint Water Crisis would either have never occurred, or would have been substantially curtailed. It should be noted that even in the 1994 report, it was recognized by the TYJT team that with the levels of lead that were being measured, that a Lead Service Line removal program would likely be required (page ES-4) at a cost that could reach \$800,000,000 (1994 USD).

The additives/approaches utilized for further study and recommendation were the following”

- 1) “Orthophosphates – These products have been shown to be an effective means of lead reduction for water similar to that of the DWSD.”
- 2) “Zinc Orthophosphates – These products are also a proven method of lead reduction, although there is concern about zinc in industrial water and wastewater.”
- 3) “pH Adjustment – This technique is also a proven method of reducing lead solubility, although higher pHs affect some industrial users and can increase calcium carbonate deposition.”

Figure 6.1.4 demonstrates the effectiveness of the chosen chemical addition, Orthophosphate, in controlling lead corrosion with the treated Lake Huron water. Figure 6.1.5 demonstrates the effectiveness of the chosen chemical addition, Orthophosphate, in controlling copper corrosion with the treated Lake Huron water. After a substantial pipe loop testing of these alternatives, the TYJT team correctly recommended a treatment strategy using phosphoric acid to add orthophosphate at a recommended dose of 1.2 mg/L as P, initially, and reducing it to a sustained dosage of 0.4 mg/L, as the optimal DWSD corrosion control treatment in their 1994 study (ES-9).

The TYJT team also indicated that the cost of dosing with phosphoric acid added an operating cost of \$0.87 annually per household in 1994 USD (\$1.50 in 2014), which is de minimis in the grand scheme of the cost of the Flint Water Crisis in damage to the residents’ plumbing, money, and human health impacts related to the corrosion damage incurred during the Flint Water Crisis. The overall system costs of the various treatment alternatives are shown on Figure 6.1.6.

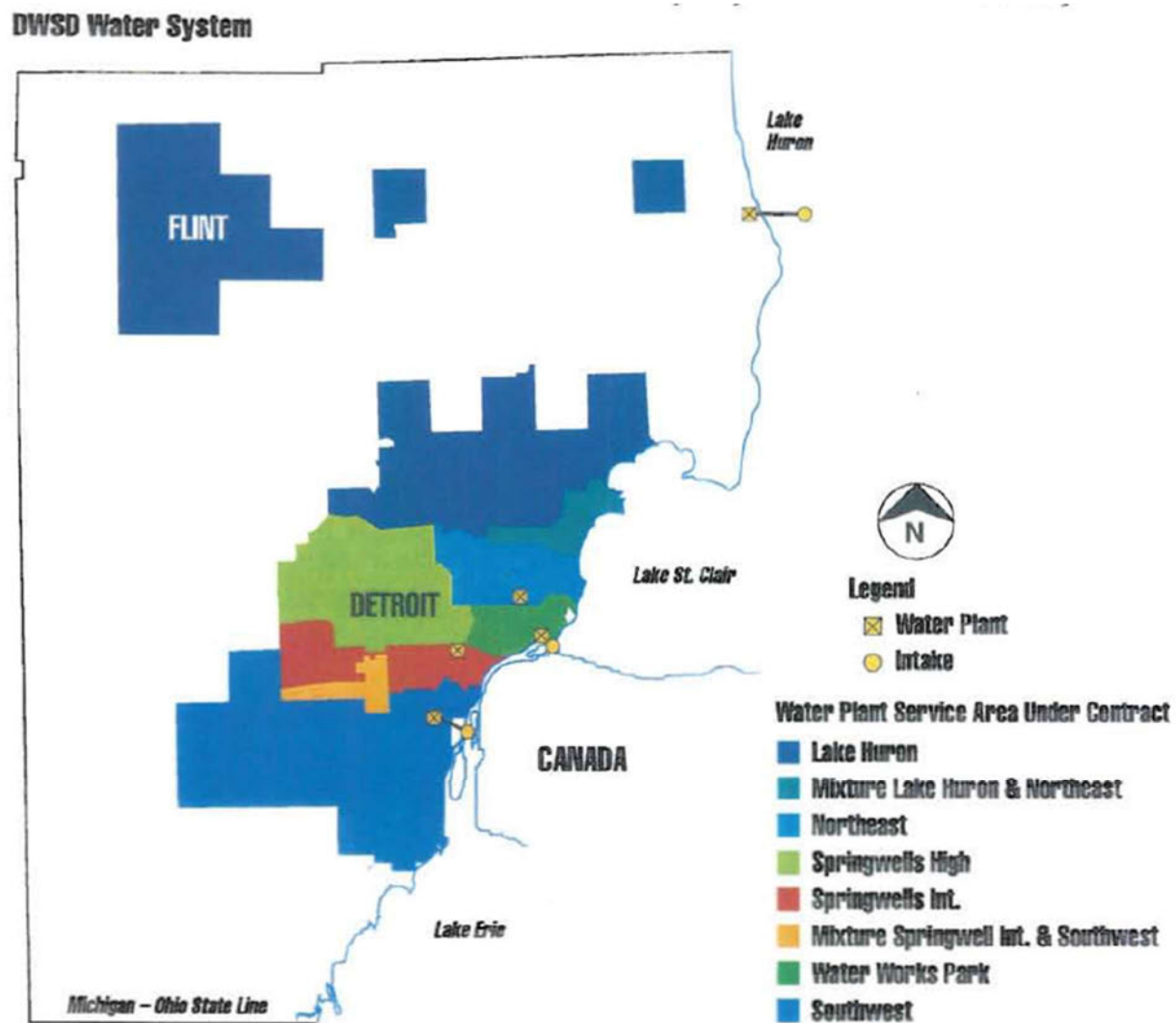
Figures 6.1.7 and 6.1.8 respectively report the relative performance/effectiveness of various corrosion control strategies and the time that was invested to properly address the development of an OCCT for DWSD (over three years). This information would have been useful for LAN and the City of Flint to recognize how long it takes to properly conduct an OCCT, which should have been a red flag regarding the proposed switch over to the Flint River water. One of the tasks accomplished in the 1994 DWSD report was to review all of the corrosion control programs in use by water supply/distribution companies located throughout the Great Lakes, not with an eye to defend what was done as LAN had done, but with an eye towards gaining knowledge to efficiently perform their work. Had LAN incorporated orthophosphate addition during their re-design of the Flint Water Treatment Plant (FWTP) modifications originally, the OCCT evaluation could have been completed while the water was being supplied from the Flint River, and the damage to resident and business plumbing would have been substantially reduced and potentially eliminated. Similarly, failure to look into what the neighboring facilities were doing to control corrosion with water of regionally similar water quality, further doomed the work done by LAN and Veolia.

Figure 6.1.9 and Table 6.1.1 present a schematic treatment system layout and the system sizing for a suitable orthophosphate dosing system that LAN could have used in their evaluation and redesign of the FWTP. Through the 1994 TYJT DWSD corrosion control study, LAN was provided with a ready to incorporate plan for corrosion control modification at the FWTP. The TYJT report was written 20 years

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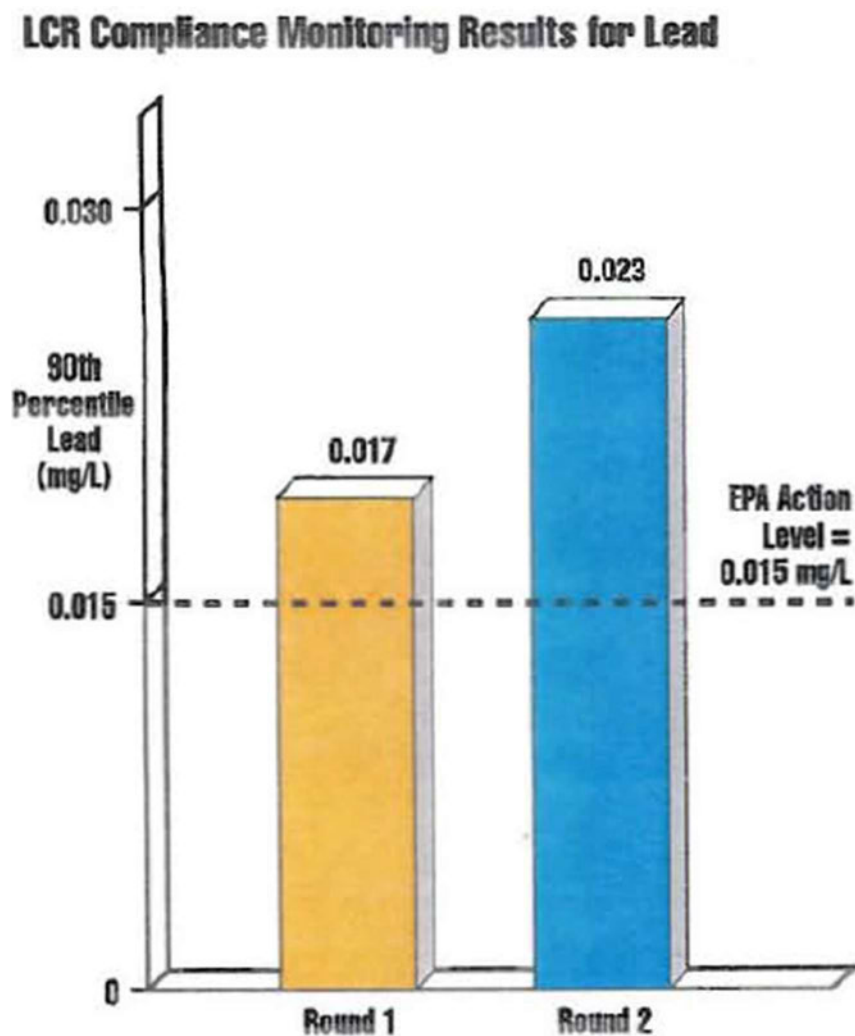
before the Flint Water Crisis but was apparently ignored by LAN during their redesign of the FWTP, and also by Veolia. It is interesting to note that it is likely that the orthophosphate addition system shown in Figure 6.1.9 could have been installed in a few weeks in 2015 for the \$40,000 cost of the Veolia contract. It should also be noted that Brown et al in 2013 laid out a logical and systematic approach, that if it had been followed by LAN and/or Veolia would have avoided the Flint Water Crisis. Note that this article relies upon the excellent work done by Mr. Mike Schock of the EPA on lead scale formation and the role of oxidants like chlorine in the formation of stable scales on lead service laterals.

**Figure 6.1-1: DWSD Lead and Copper Corrosion Control Optimization Study (1994), Figure ES-1: DWSD Water System.**



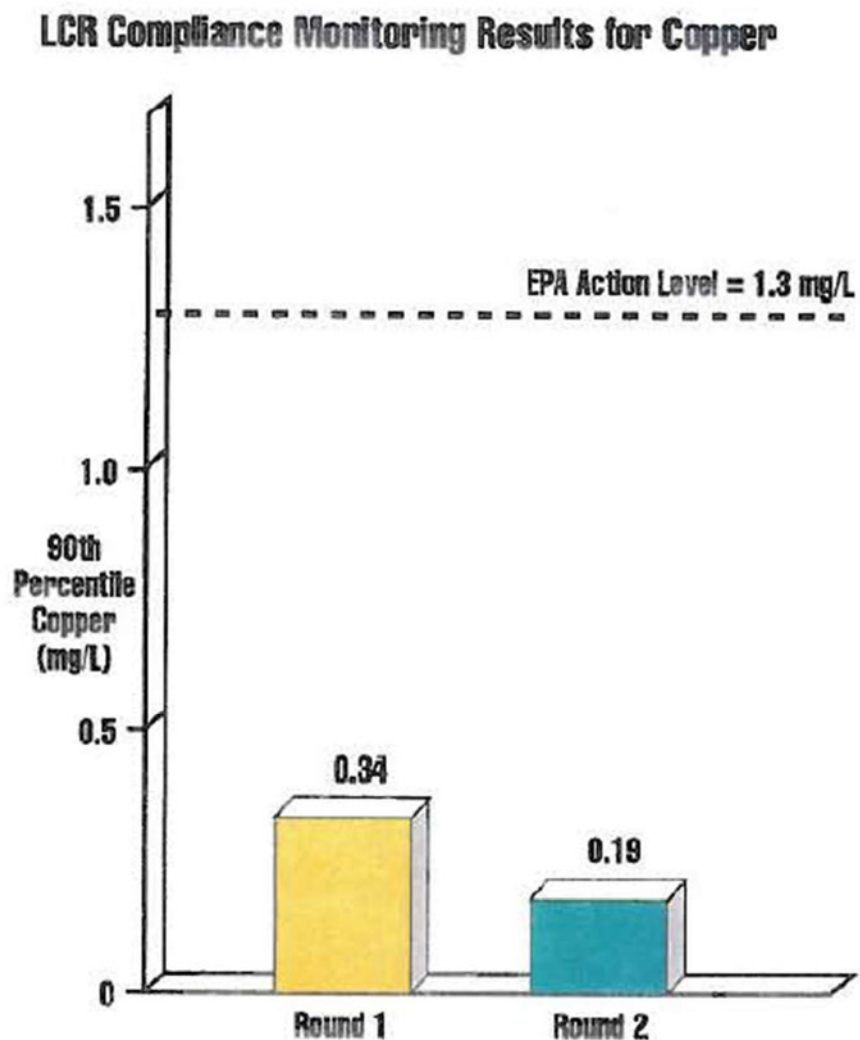
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**Figure 6.1-2: DWSD Lead and Copper Corrosion Control Optimization Study (1994), Figure ES-2: LCR Compliance Monitoring Results for Lead.**



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Figure 6.1-3: *DWSD Lead and Copper Corrosion Control Optimization Study (1994)*, Figure ES-3: LCR Compliance Monitoring Results for Copper.

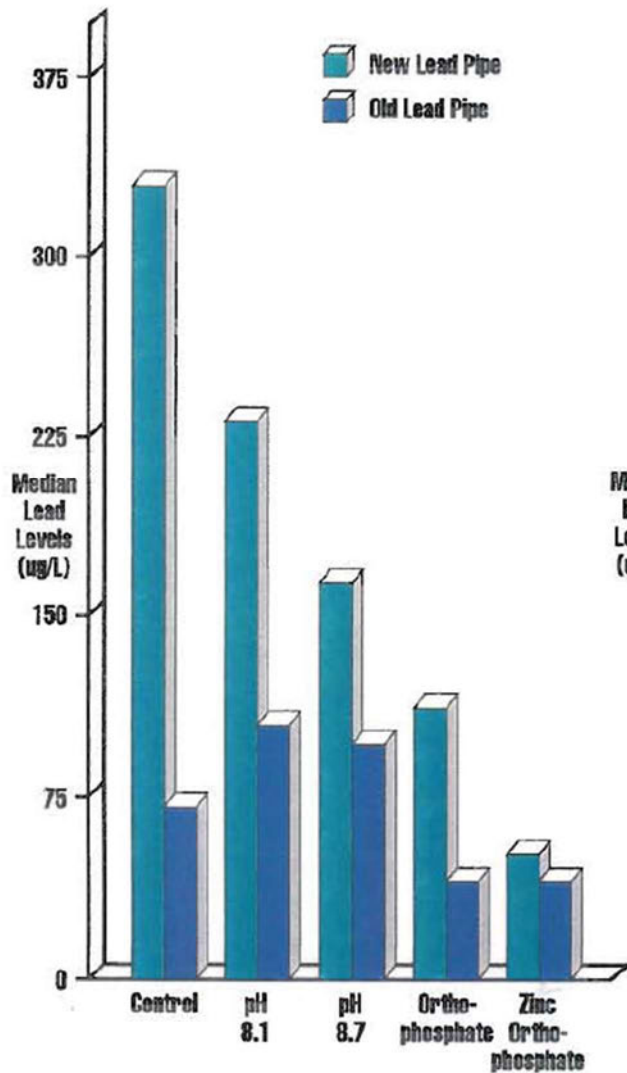


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**Figure 6.1-4: DWSD Lead and Copper Corrosion Control Optimization Study (1994), Figure ES-5 and ES-6: Measured lead levels from lead pipe (left), brass and soldered copper pipe (right) during corrosion control optimization testing.**

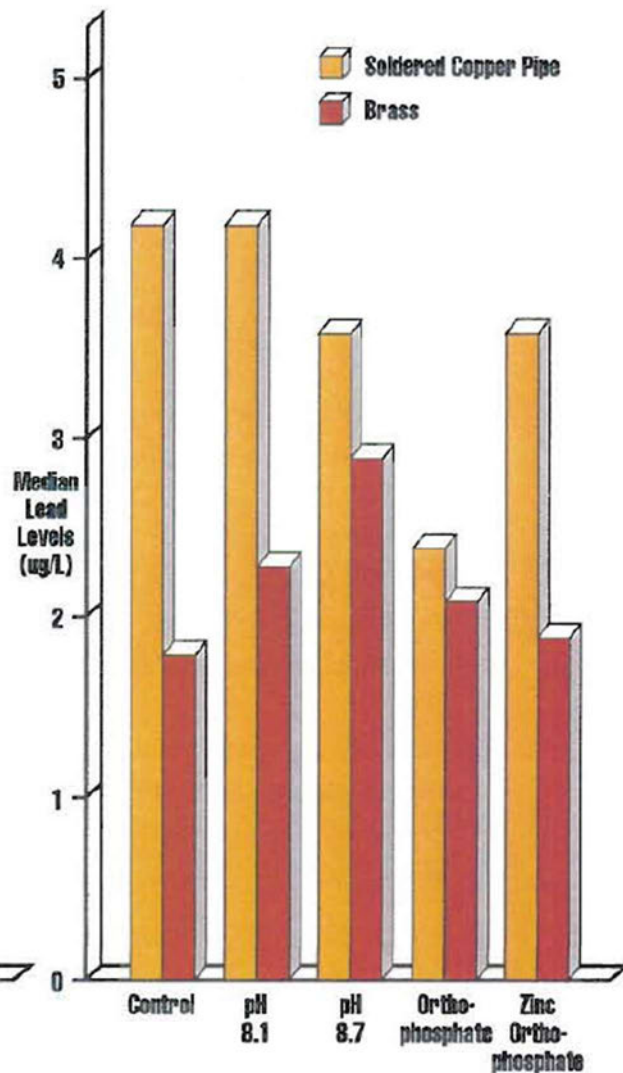
**Figure ES-5**

**Relative Lead Levels from Lead Pipe**



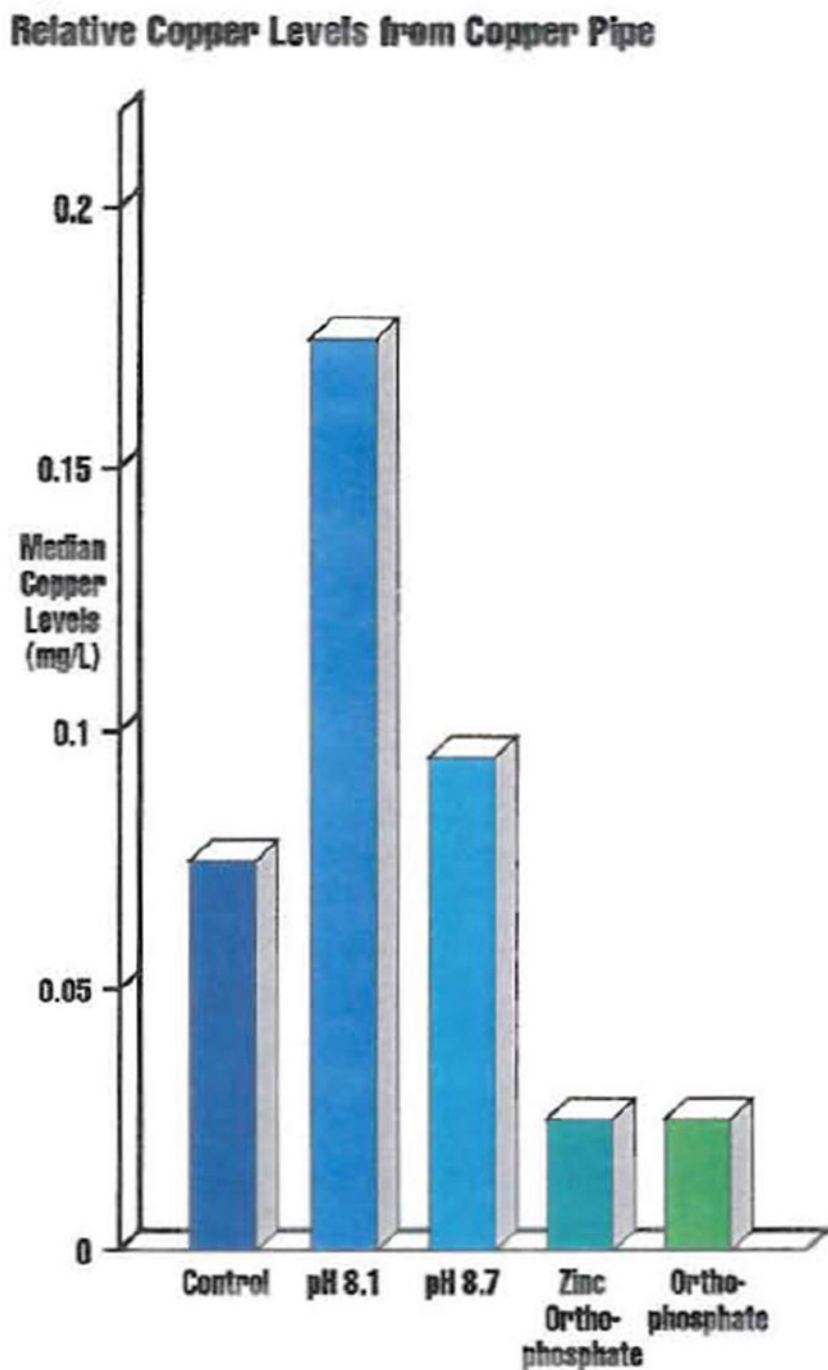
**Figure ES-6**

**Relative Lead Levels from Soldered Copper and Brass**



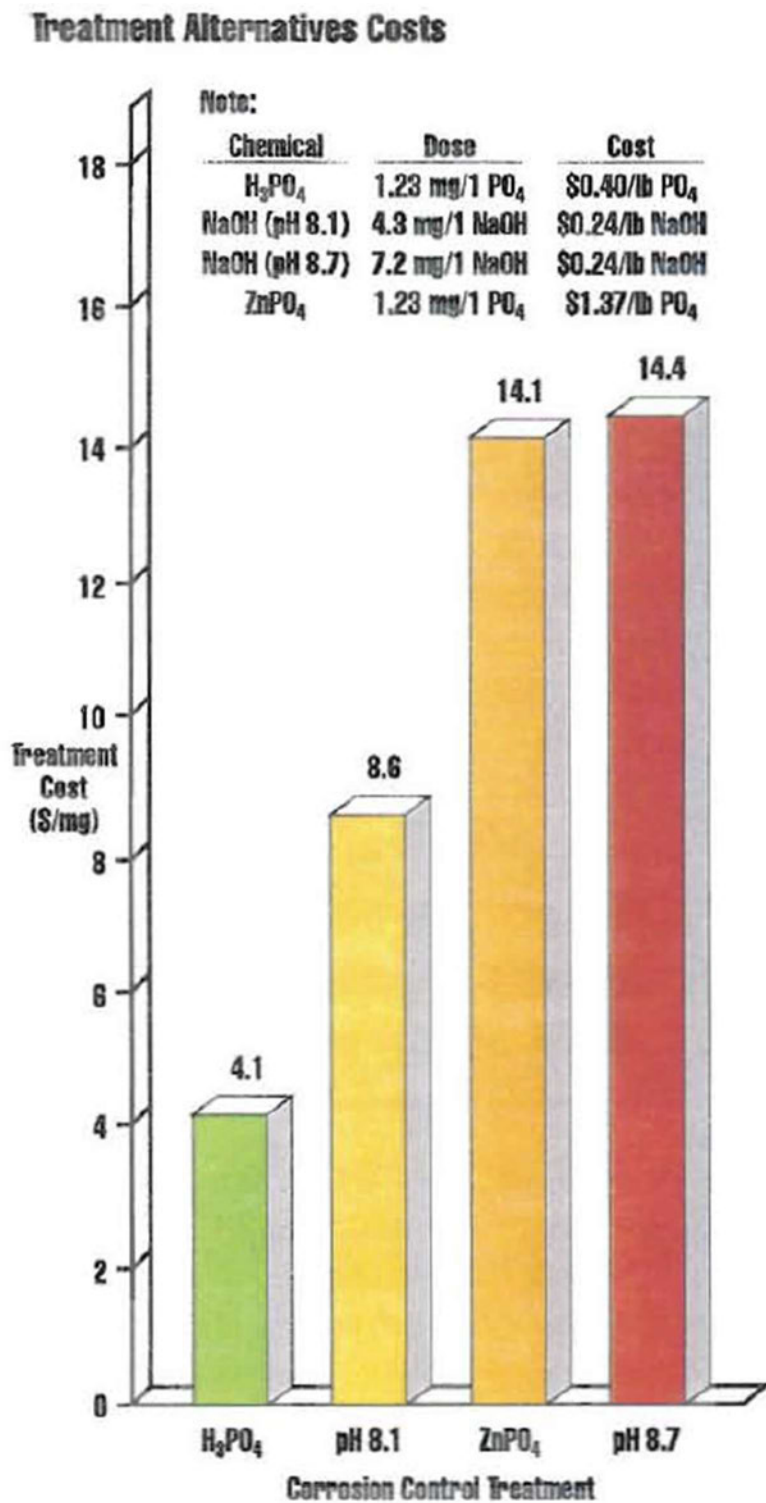
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Figure 6.1-5: *DWSD Lead and Copper Corrosion Control Optimization Study (1994)*, Figure ES-7: Measured copper levels from copper pipe during corrosion control optimization testing.



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Figure 6.1-6: *DWSD Lead and Copper Corrosion Control Optimization Study (1994)*, Figure ES-8: Treatment Alternative Costs.



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Figure 6.1-7: *DWSD Lead and Copper Corrosion Control Optimization Study (1994)*, Figure ES-9: Alternative Ranking by Criteria: lowest score is best.

**Alternatives Ranking  
by Criteria**

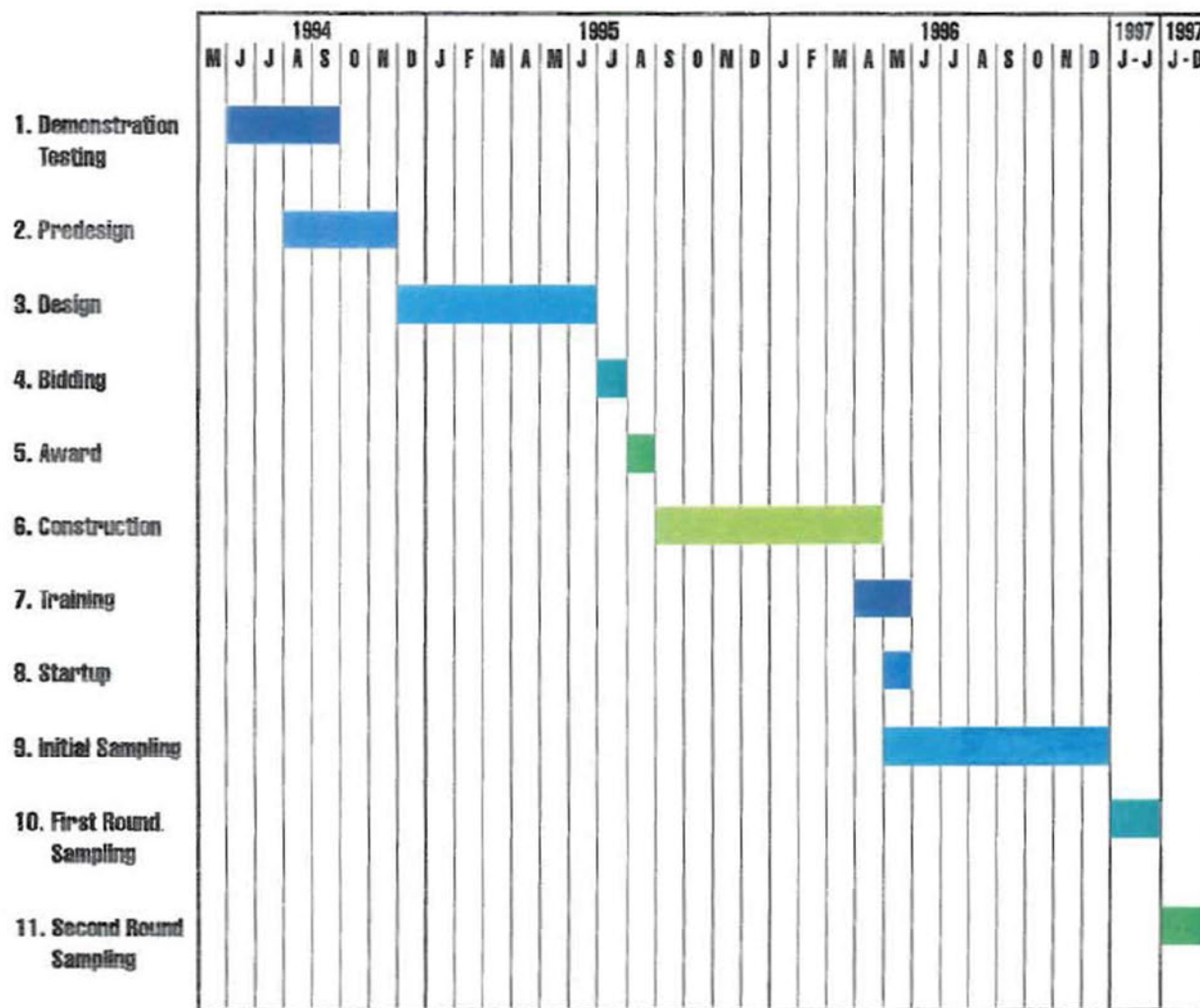
Treatment	Evaluation Criteria				Weighted
	Performance wt. = 2	Feasibility wt. = 1	Reliability wt. = 1	Cost wt. = 1	
Phosphoric Acid	2	1	1	1	7
Zinc Orthophosphate	1	4	2	3	11
pH 8.1	4	2	3	2	15
pH 8.7	3	3	4	4	17

Legend: 1 = Best; 4 = Worst

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**Figure 6.1-8: DWSD Lead and Copper Corrosion Control Optimization Study (1994), Figure ES-10: DWSD Corrosion Control Implementation Schedule.**

### Implementation Schedule



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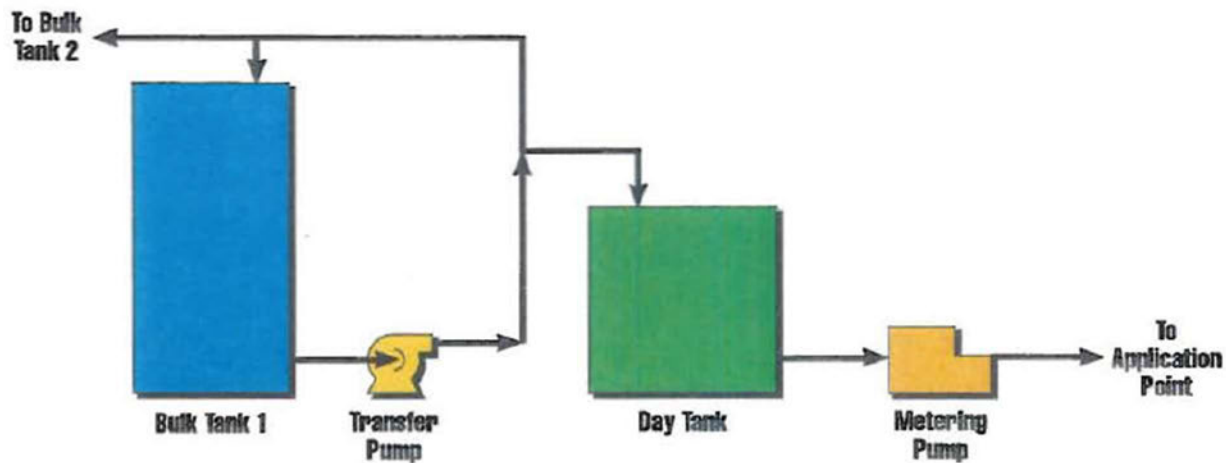
Table 6.1-1: *DWSD Lead and Copper Corrosion Control Optimization Study (1994)*, Table ES-1: Chemical Equipment Summary.

<b>Chemical Equipment Summary</b>	<b>Southwest Water Plant</b>	<b>Water Works Park Water Plant</b>	<b>Northeast Water Plant</b>	<b>Springwells Water Plant</b>	<b>Lake Huron Water Plant</b>
<b>Number of bulk tanks</b>	2	2	2	2	2
<b>Bulk tank capacity, each (gal)</b>	4,000	4,000	4,000	6,000	4,000
<b>Number of day tanks</b>	1	1	1	1	1
<b>Day tank capacity (gal)</b>	200	200	200	400	200
<b>Number of feeders</b>	3	3	3	3	3
<b>Feeder capacity, each (gpd)</b>	1 @ 200 2 @ 650	1 @ 300 2 @ 650	1 @ 250 2 @ 800	1 @ 600 2 @ 1,500	1 @ 350 2 @ 650
<b>Number of transfer pumps</b>	2	2	2	2	2
<b>Transfer pump capacity each (gpm)</b>	15	15	15	30	15

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Figure 6.1-9: *DWSD Lead and Copper Corrosion Control Optimization Study (1994)*, Figure ES-11: Schematic of Liquid Chemical Feed system for corrosion control chemicals.

**Liquid Chemical System Schematic**



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## 7 Failures by LAN and Veolia to Provide Competent Engineering Services

### 7.1 LAN's failure to meet the standards of care applicable to professional engineers

LAN failed to meet the standard of care for professional engineers in multiple ways during their work in Flint. LAN was the principal engineer assisting the City with the switch from DWSD to treated Flint River water. LAN failed to recommend or require that the water be treated for corrosion control. LAN failed to assess the possible impacts that corrosive water could have on the distribution piping and the impacts on health of the residents that would occur due to the release of lead caused by the lack of corrosion control treatment. LAN failed to notify the appropriate authorities and/or the public when they were informed that the MDEQ was not requiring corrosion control, which LAN surely knew was required under the federal regulations and by best engineering judgment. LAN should have provided their client with written documentation of these requirements and notified the appropriate authorities if the City was overruling their recommendations resulting in actions that were harmful to the people and property of Flint. Engineering work performed by LAN directly contributed to, and at a minimum allowed for, the destruction of piping systems throughout Flint, microbial contamination in the distribution system, and exposure of the citizens of Flint to high concentrations of lead.

#### 7.1.1 LAN failed to insist upon a corrosion control optimization study before implementing the switch to the Flint River

LAN failed to require, or even to adequately recommend that the City of Flint perform a corrosion control treatment plan before switching water sources and treatment systems. A high-quality corrosion control evaluation is needed when switching water sources from well-treated and corrosion inhibited Lake Huron water to poorly treated and highly corrosive Flint River water. LAN should have insisted that an appropriate corrosion control study be conducted BEFORE the switch occurred. In addition, LAN should have known about the 1998 Snell engineering report, which detailed exactly what was needed to address the issue of the switch to the Flint River water, including the use of a phosphate corrosion inhibitor.

Interestingly, Mr. Green, the lead engineer from LAN on the project, at the time of his deposition apparently did not understand the requirements or methods involved with modern corrosion control. In his deposition, Mr. Green described his understanding of corrosion control based on softening (Green 2020, p. 30 L12-14):

*... however, [Flint was] providing softening. At the time, softening, and today, is an accepted form of corrosion control.*

Mr. Green's lack of understanding of modern corrosion control treatment was highlighted by the EPA staff in Mr. Schock's Deposition Vol 1, where he testified as follows [Schock p. 71 (L7-14)]:

*When we went to Flint for the first time, we had some conversations with them and with an engineering consultant, they were working with, that was really talking about corrosion control being centered around calcium carbonate precipitation, in kind of old 1930's, 1940's kind of corrosion control.*

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The person that Mr. Schock met with was Warren Green, the project lead engineer from LAN for the City of Flint (Schock personal communication 2020). The leader of the LAN team was nearly 100 years behind the times with respect to corrosion control technology, and accordingly the water treatment system implemented did not meet the needs with respect to corrosion control or water quality in the twenty first century. Mr. Green was involved with Flint, since at least the early 2000s, but he had no idea what was involved in conducting a suitable study to address the corrosion evaluation needs before the switch was made.

Mr. Green and his team recommended that the treatment plant be run under a trial run for 60-90 days. However, a meaningful study of this nature to stabilize the corrosion treatment process would take two years, as testified by Mr. Schock of the EPA. That study would have identified the appropriate dose of corrosion control inhibitor (such as, orthophosphate) using pipe loop testing. In the end, there was very limited test trial period conducted before the Flint River water was distributed to the residents of the City of Flint, and that test run wasn't utilized to optimize corrosion control. With regards to the required period for performing a corrosion control analysis, Mr. Shock stated (Schock 2020 p.103 L7-14):

*So there's no hard and fast specific time frame, but by and large, in our experience, a couple years is a rough estimate of what it would really take to get a study done. And the studies need to be done, and it's a well-known best practice in the corrosion control field before you make a treatment change that's significantly going to affect corrosion.*

Clearly, Mr. Green and the LAN team did not know what was needed to address the corrosion issues involved in Flint. The disastrous results of this ignorance are obvious based on what occurred after the switch to the Flint Water Treatment Plant in 2014 including exposing the residents of the City to high concentrations of lead and irreversibly accelerating corrosion throughout the distribution system and household piping.

Interestingly, and contrary to his deposition testimony, is important to note that during his trial testimony, Warren Green admitted repeatedly that engineering best practices required a corrosion control study prior to the Flint River going into use as the primary water source for Flint.

#### 7.1.2 LAN failed to identify the absence of corrosion control as a threat to human health and property.

The lack of corrosion control utilization on the Flint River allowed highly corrosive water to enter the distribution system. The presence of this water resulted in the release of high concentrations of lead and resulted in irreversible damage to the health of the citizens of Flint and to their piping systems throughout homes and business in Flint. The NSPE code of ethics requires that "engineers must hold paramount the safety, health, and welfare of the public[.]"

If LAN had identified that the water without corrosion control would result in damage to property and a threat to human health, they had a professional responsibility to report the problem and require that it be addressed as part of their work (or work by other consultants). There is no documentation in the written reports from LAN that the absence of corrosion control was a threat to human health and property. Failure to identify these issues and failure to address them accordingly was below the standard of care.

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### 7.1.3 LAN failed to conduct, or recommend that the City of Flint conduct basic assessments of the corrosivity of Flint River water

The project staff from LAN did not conduct a basic assessment of the corrosivity of the water from the Flint River. We are not aware of any documentation from LAN where calculations or testing were performed to determine if the water from the Flint River was at risk for corrosion issues. Given LAN's years of work in Flint, they should have been aware of the presence of lead pipes, high lead fixtures, and leaded solder in Flint and that a corrosion assessment was necessary. LAN should have been aware that the dramatic change in water quality from DWSD (with corrosion control) to the Flint River required a corrosion control study. LAN did not appear to perform any assessment of corrosion concerns, such as calculating CSMR values. LAN should have recommended, and in fact should have required, that the City of Flint conduct a corrosion control study prior to the switch (which at trial Warren Green admitted).

The July 2011 report by LAN provides an example of their lack of competence and lack of consideration of the corrosion issues. The report, entitled Analysis of the Flint River as a Permanent Water Supply for the City of Flint, details the adequacy of the Flint River as a source of water and outlines the plant upgrades required. There is no mention of corrosion control in the required plant upgrades and no discussion of the impacts of the highly corrosive Flint River water on the distribution system. This oversight is significant, given the age and the materials of construction of the piping systems in Flint (copper with high lead solder, lead, steel, high lead brass, and cast iron), the use of corrosion control on the lake water previously supplied by DWSD, and the potential impact on the health, safety and welfare of the citizens of Flint. It should be noted that LAN recommended lime-soda ash treatment (not supported by the water chemistry). Lime softening does not constitute adequate modern corrosion control and was never recognized in the water profession as a corrosion control mechanism (in fact the hard scaling water is less corrosive than softened water). Suggestions that lime-soda softening is adequate corrosion control are factually inaccurate and demonstrate an utter and complete ignorance of water quality and corrosion science.

The report mentioned "phosphate" (type unspecified) in a cost analysis included in the appendix (LAN 2011, Appendix 8, p. 10) but made no recommendation in the text of the report. LAN did not present justification for dosing rates, nor did they include the basis for the inclusion of this word in the appendix. This abstract reference in a cost of service analysis in the appendix of the report is not a meaningful recommendation for corrosion control. Failure to make these recommendations was below the engineering standard of care as they resulted in damage to property and were not protective of human health.

In June of 2013, LAN provided their proposal for the engineering work to put the Flint Water Treatment Plant into service on the Flint River water (LAN 2013). That proposal was negligent far below what the standard of care requires in that it did not call for a corrosion control study nor did it specify the installation of corrosion control equipment (LAN 2013). The proposal outlined approximately \$2.5MM of engineering consultancy fees for LAN.

The proposal consisted of three tasks: 1) Plant Test Run; 2) Engineering Planning Report; and 3) Design Phase Services. No mention of a corrosion control study is made in the proposed scope. The proposed scope provides a description of capital improvements items "a" through "k," totaling tens of millions of dollars (LAN 2011, p. 9). Not one of the line items included either evaluation or installation of corrosion control chemical dosing program. LAN failed to recommend that the City of Flint perform a corrosion control study, and LAN failed to include an assessment of corrosion in the work they performed. LAN

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made recommendations to the City on August 22, 2013 regarding the upgrades needed to bring the plant into service. LAN again failed to recommend that corrosion control or a corrosion control optimization study was needed (Green 2020, p. 97 L2-20).

As confirmed by Mr. Green in his deposition, LAN's contract was to assist with the City's needs to upgrade the water treatment plant for fulltime service on the Flint River water as described in the exchange below (Green 2020, Vol. 3, p. 40 L20-p. 41 L4):

*[Question] ...LAN committed to evaluating the Flint Water Treatment Plant and upgrading it to provide continuous water supply service for the City of Flint, correct?*

...

*[Answer, Green] That's what this says.*

Mr. Green confirmed that LAN was serving as the "water treatment advisor for the City of Flint" (Green 2020, Vol 3 p. 44 L4-5). In that role, LAN would have overseen the design and engineering for the facility, which necessarily would include water treatment process design and should have included corrosion control evaluations and treatment. Mr. Green later claimed that later LAN's scope was reduced, and they were "no longer serving as a treatment advisor, but were assigned some specific projects to perform" (Green 2020, Vol 1, p. 26 L8-10). However, their contract required any modifications to be made "in writing and signed by the parties or the authorized employee, officer, board, or council representative of the parties..." (Green 2020, Vol 3, p. 35 L9-13). Although there were multiple change order issued on the contract, there is no written record of a change to remove LAN as the *water treatment advisor*. Mr. Green confirmed the lack documentation on the subject in the following exchange (Green 2020, Vol 3, p 54 L22 – p. 55 L3):

*[Question] ...So we don't have any written document saying that LAN's scope was reduced, and you don't remember any verbal statement saying that your scope has been reduced, correct?*

...

*[Answer, Green] No*

LAN was contracted to provide critical engineering that the City of Flint required in order to bring the Flint Water Treatment Plant into full-time service. Now, years after the start of the Flint Water Crisis, Mr. Green and LAN are claiming that they had a limited role that did not include water quality or corrosion evaluations/treatment. Yet, Mr. Green could not provide documentation that this critical role had been removed from their contract scope.

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- 7.1.4 LAN failed to notify governmental authorities (as is now mandated by the State of Michigan) when MDEQ determined that corrosion controls were not required and Flint insisted on only doing what was required by MDEQ

The engineering staff for LAN should have been aware that the Lead and Copper Rule (LCR) and good engineering practice require that a corrosion control study be performed prior to allowing a switch from the DWSD supply to the Flint River. And Mr. Green acknowledged as such during the trial. It is the responsibility of engineers in the water treatment field to be familiar with the applicable Federal and State regulations, such as, the LCR, and with good engineering practice. The MDEQ should have required the City of Flint to perform a corrosion control analysis and development of a corrosion control treatment strategy before allowing the switch to Flint River water. LAN should have very strongly encouraged the City to develop a corrosion control strategy, even if the MDEQ did not require one. Unfortunately, Mr. Green and the LAN staff did not insist that a corrosion study be completed before the plant could be placed into operation (Green, 2018; p. 162 L21-163 L2):

*[Green]: I felt like that was an issue that needed to be investigated and that we did need to wait until the plant started up to start investigating that.*

*[Question]: And, uh, what did Mr. Johnson, what was his response to your statement?*

*[Green]: He told me that he had been told that they weren't gonna do anything that M-D-E-Q didn't require.*

Mr. Green provided additional insights on that meeting which included Mr. Daugherty “Duffy” Johnson, the Utilities Director for Flint (Green, 2018; p. 158 L5-11):

*[Question]: ...what was the nature of your discussion with Mr. Johnson regarding partial softening and corrosion control?*

*[Green]: Mr. Johnson and I did not discuss partial softening. When Duffy made a statement as the meeting was breaking up to the effect that, well, I guess we dodged a bullet on not having to put in corrosion control, we save the money.*

Mr. Green states that he was not comfortable with the lack of a corrosion control analysis prior to start up and expressed that to Mr. Johnson. Mr. Green and LAN had a professional and ethical responsibility to object to the treatment plant start up without a corrosion control study being performed or at least incorporating the installation of a corrosion inhibitor injection system. These actions were below the engineering standard of care, because LAN ignored their duty to inform governmental authorities that their judgement was overruled by the client.

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The ASCE Code of Ethics (attached) states that:

*Engineers whose professional judgment is overruled under circumstances where the safety, health and welfare of the public are endangered, or the principles of sustainable development ignored, shall inform their clients or employers of the possible consequences.*

Further expanding on this point stating that “engineers must seek to educate the client and public as to the risks inherent in a decision that the engineer is resisting. The degree of education must be appropriate to the audience and risks.” If LAN and Mr. Green believed that the MDEQ was incorrect, they had a professional obligation to inform their client on the issue (when that decision could harm the health, safety, and welfare of the residents of Flint). Those recommendations from LAN to the City of Flint must have been documented in writing to comply with the NSPE Code of Ethics, yet they were not.

If Flint elected to override their recommendations regarding the need for corrosion, then LAN had a further obligation to notify the regulators of the error made by MDEQ staff. The “engineer must alert authorities if the client seeks to implement an action which the engineer believed violates the applicable engineer standard of care and/or results in an unacceptable risk of public harm.” If LAN believed the decision by Flint and MDEQ would harm the public, those objections must be provided in a written record. If LAN did not believe that harm to the health of the citizens of Flint would occur, then they are admitting their own incompetence and failure to meet the standard of care. Years of work and millions of dollars later, we are not aware of LAN recording any such observations or recommendations to this effect.

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7.1.5 LAN failed to identify the ongoing corrosion problem or the substantial threats to human health and property that the failed treatment system created even after significant problems emerged

LAN failed to identify that the switch to Flint River water created significant threats to human health and property as a result of the production of highly corrosive drinking water. LAN continued to work on the project following the plant start-up in April 2014, via a series of contract extensions. By the fall of 2014, the water system experienced a wide variety of problems including: red water complaints, broken distribution pipes, microbial contamination problems, and high levels of disinfection byproducts (TTHMs), and a substantial number of consumer complaints.

The treated water was so corrosive that it impacted the General Motors Corporation (GMC) manufacturing processes (Masten, 2016). To address these problems, GMC stopped using the Flint River water via a connection to the Flint Township system (returning to DWSD water) at a cost of over \$440,000 to the City of Flint to make the connection.

Even with these issues, LAN failed to raise any red flags about need for corrosion control to the public, to the regulators, or to City officials. In their *Action Plan* in their report from 2014 on TTHM issues, LAN stresses that “the City of Flint has signed an agreement with the Karegnondi Water Authority (KWA) to purchase raw water drawn from Lake Huron” and the project is “expected to be operational by late 2016” (LAN, 2015b). LAN fails to acknowledge any corrosion problems in their report(s), and failed to provide a strategy that included corrosion control. Instead, LAN (and Veolia) suggested increasing—rather than decreasing-- the ferric chloride dosing, which would raise the CSMR, and increase corrosivity of the treated water. LAN concluded the following regarding ferric chloride dosing in the August 2015 (LAN, 2015b, p. 18 of 22):

*Increasing the dose rate of ferric chloride is an operation change that can easily be implemented without the need for any additional equipment. Test results show that over 40% [Trihalomethane Formation Potential] removal can be obtained with a dosage of 60 mg/L  $Fe^{3+}$  or higher.*

LAN also recommended that the ferric chloride concentrations be increased in the February 2015 report (LAN 2015a, p. 18 of 22). This recommendation is said to be based on the “2002 Treatability Study [AB&H], jar testing completed by LAN, and a review of 2014 ferric chloride doses compared to THM levels” (LAN 2015a, p 18 of 22).

The corrosion problems occurring throughout the City were ignored by LAN. A simple root cause analysis of these problems would have pointed directly to the lack of corrosion control. Instead, LAN allowed these effects on human health and damage to piping systems to continue.

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## 8 Veolia's Failure to Provide Competent Engineering Services

Veolia North America (Veolia) is the North American arm of the Veolia Group based in Paris, France, which provides services for a wide range of industries including utilities, municipal services, transportation, energy, mining, and manufacturing. On Veolia's website they claim that "our experts deliver the water treatment solutions that improve the quality of people's lives in communities around the world," and that "communities trust us to ensure their safety and to meet the most stringent performance standards." Veolia provides drinking water to approximately 90 million people daily. (<https://www.veoliawatertechnologies.com/en/veolia-water-technologies>, accessed 6/2020).

In January 2015, the City of Flint issued a request for proposals to address the City's ongoing water quality issues. In its request for proposals, the City stated that it was "seeking a consultant to review and evaluate the water treatment process and distribution system, provide recommendations to maintain compliance with both state and federal agencies, and assist in implementing accepted recommendations" (Nicholas 2019, Exhibit 7, Veolia 006438). Veolia responded to that RFP on January 29th, 2015. As described in their response to the RFP, Veolia stated that "Veolia would mobilize a team of experts, including our two prominent water SMEs, from our corporate Technical Services Group [an in-house team of technical and management experts that support the company's projects and operations throughout North America]" (Nicholas 2019, Exhibit 7, Veolia 003120).

The lead technical staff provided by Veolia were Mr. Marvin Gnagy, P.E. and Mr. Theping Chen, P.E.. The VNA proposal stated Mr. Gnagy had more than 37 years of "water quality management experience, and is a certified Water Operator in Ohio and a registered Professional Engineer" (Veolia 006486). Mr. Chen was described as having "close to 30 years of water engineering, operation, and research experience, and he spent 15 years as a water consulting engineer in Michigan and is a registered Professional Engineer in the State of Michigan" (Nicholas 2019, Exhibit 7, Veolia 006487).

Veolia stressed that it understood the significance and urgency of the water quality issues facing the City:

David Gadis, the Vice President of Veolia's Municipal and Commercial Business, stated "we understand the frustration and urgency in Flint," and that Veolia was "honored to support your community with our technical expertise so that together we can ensure water quality for the people of the city of Flint."

Veolia claimed to have "extensive experience handling challenging river water sources, reducing leaks and contaminants and in managing discolored water," and that Veolia "look[s] forward to helping Flint's team find ways to address and improve the city's drinking water operation." [Accessed 6/2/2020: <https://www.cityofflint.com/2015/02/10/flint-hires-international-urban-water-experts-of-veolia-northamerica-to-assess-citys-water-issues/>].

The contract with Veolia for their services was signed on February 4th, 2015 and included a not to exceed contract amount of \$40,000. The scope of work in the contract was extensive and was to "provide consulting and related services to [the City of Flint] in connection with the project as outlined in Contractor's Proposal dated January 29, 2015" (City of Flint, 2015). In the Veolia proposal, they stated that they will be providing a broad scope of services (Nicholas 2019, Exhibit 7, Veolia 006489):

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*In order to respond to the immediate needs of your defined scope of work, we anticipate mobilizing a team of technical, operations, maintenance and communication SMEs to: calibrate daily water quality samples with the City's hydraulic model; refine the operation strategies for the plant and distribution systems; coordinate daily efforts across plant, operation and maintenance staff; and to alleviate continued concerns from the public through a public communications process.*

Veolia then went on further describing their long-term approach (Nicholas Exhibit 7, Veolia 006489): For the longer-term type of approach, Veolia would set up a single lump sum price for the study, implementation and long-term services after review and discussion with the City and selecting your preferred approach – the [Peer Performance Solutions] approach or the contact [Operations and Maintenance] approach (note that this approach is identical to the approach they used in Pittsburg and for which that were sued for gross negligence with a demand for the return of over \$12 million charged in fees to Pittsburg).

Veolia's Peer Performance Solutions (PPS) was a business model which was "a form of consulting, but instead of being paid upfront, [Veolia] take[s] the risk for the savings and then we share in that savings" (Nasuta, 2019, p. 37 L20-23). Under the PPS structure, Veolia develops and implements strategies to address issues that the water utility has. Veolia would be paid based on the achievement of performance metrics. Under an Operations and Maintenance (O&M) approach, Veolia would provide private operations for the utility, typically taking over the role of the City's operators. Both of these structures suggest that Veolia viewed their work in Flint as a gateway to a much larger project. The business development department for Veolia later admitted that they were trying to utilize this project to gain more work from Flint (Nicholas 2019, p. 768 L 22- p.269 L 5):

*[Question] While you were performing these services in Flint, you were trying to upsell the city to a much larger contract that would have brought in more than a million dollars a year for Veolia; is that correct?*

*[Answer, Nicholas] Correct*

Members of the Veolia's business development team clearly viewed the contract as a means to achieve much larger contracts for services in Flint. Later describing the project, Veolia's Robert Nicholas wrote "we saw this as a paid sales effort so not as concerned about the dollar value" (Nicholas 2019, Exhibit 24, p. 1). Veolia agreed to help the City of Flint with its water system problems and assigned two professional engineers, Marvin Gnagy and Depin (Theping) Chen, to that project. Those engineers were bound by the professional and ethical obligations of engineers. Veolia performed broad analyses of the water system and both in their presentations and reports they made statements that the water treatment plant and distribution system were in compliance with state and federal water quality regulations. In completing their work, the Veolia engineers both downplayed the severity of the problems in Flint, and neglected to include Veolia's assessment of the Lead and Copper data within their public presentations, and completely failed to address the presence of other problems (such as the lack of any form of corrosion control in the distribution system, the presence of highly corrosive water, the human health and property damage risks associated with corrosive water, and the specific risk of lead leaching). In short, Veolia wholly and intentionally mislead the public, and violated their ethical obligation to serve the public first before their profits.

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8.1.1 Veolia's failure to publicly identify the absence of corrosion control as a threat to human health and property.

Veolia was aware that corrosion control was needed in Flint, but in their February and March reports, they never stressed to the City, the public, or the regulators, the necessity or urgency of that requirement. In fact, as admitted by Mr. Gnagy for the first time during his trial testimony, he was given an incomplete set of lead and copper test data from the University of Michigan Flint campus, which led him to erroneously base his the 90<sup>th</sup> percentile assessment and for which he used that assessment as the basis to remove the lead and copper portion of the Veolia Power Point presentation. And as an example of his ineptitude, Gnagy didn't even realize he had been provided incomplete test results until he was on the stand in 2022, during his cross-examination. His presentation was also being directed by non-technical Veolia personnel like Mr. Nicholas as evidenced in the email below (VEOLIA 00587). In this email, the non-technical Mr. Nicholas a business development manager in a Veolia office in Florida is directing the technical staff that the random sampling conducted to date is of no value because among other things Mr. Nicholas believes that the samples weren't taken properly. What is the basis of his opinion and where does he have the knowledge to profess these opinions and provide direction to the technical staff at Veolia.

**From:** Nicholas, Robert [mailto:robert.nicholas@veolia.com]  
**Sent:** Friday, February 06, 2015 4:43 PM  
**To:** Kelly Rossman-McKinney  
**Cc:** Edwards, Scott; Whitmore, Paul; Matt Demo; David Gadis (david.gadis@veolia.com)  
**Subject:** Re: FW: Water Quality Advisory Committee

The Water Quality Committee is a good idea if properly organized but the sampling may not be. I suggest the City needs to slow down and think out more carefully the sampling.

- Testing needs to done by qualified water labs. A reputable entity like the university or a well known lab would be better. Testing needs to follow EPA and State collection and analytic requirements.
- Testing locations need to be confirmed in advance with the City and State which is part of state requirements. Sampling all over town isn't going to help and might well hurt. There needs to be coordination with the water company of where, when and how.
- What parameters are being tested. The discussion this afternoon leads us to believe different testing is needed to help.
- **What do you do if a bad sample occurs.** This could cause mass panic with unqualified people saying water isn't safe.
- Poor sampling techniques cause just as many bad samples as actual problems. There are also holding times and transport requirements on taking samples which many of these entities may not have.
- The random water samples already coming in aren't of any value because they weren't taken properly, are logged by time and location and the department isn't ready for all the data.

The discussion this afternoon with their staff was good and we have ideas already. This testing idea needs vetted to help the situation and not hurt. We can certainly meet with the Committee but won't be as helpful as after we have a chance to review the plant, distribution system and do some analysis.

Neither Veolia or LAN ever completed the standard chloride sulfate mass ratio ("CSMR") analysis used to assess the corrosivity of the water, even though the data needed was readily available in their own project documents. Had LAN or Veolia performed a CSMR calculation, the results would have shown that the water exhibited a serious concern regarding lead corrosion, which quite obviously posed a threat to human health and property. Failure to calculate the CSMR indicates a lack of familiarity with modern corrosion engineering, and indicates that their team needed additional corrosion engineering expertise (such as Mr. Mike Schock from EPA, located approximately 300 miles away from Flint). Making the

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situation worse is the fact that the engineers from Veolia were well aware that the best engineering solution for resolving the Flint Water Crisis was for the City to return to DWSD water, but in Veolia's February and March reports they failed to make reference to or directly provide that option in their presentations and reports. The engineers from Veolia did not meet the Standard of Care and failed the public by allowing continued exposure of the residents to harmful concentrations of lead.

Veolia professional staff surely recognized the shortcomings of the training of the Flint water treatment personnel; however, no such documentation of their concerns exists in writing. As correctly pointed out by Mr. Ringstad in a question to Mr. Schock in his deposition (Schock 2020, Vol I p.166 L12-17):

*Q: And in that time frame, were you just a phone call or an e-mail away, you know, for City of Flint or for DEQ to reach out to you?*

*A. Yeah, that's the way it always works*

Veolia could have reached out as easily when (or if) they realized that they needed assistance, but they didn't do so. As described by Mr. Glasgow, Veolia did not provide adequate warnings about the lack of corrosion control, and that the City would have followed their advice if they had. Had Veolia provided the City with the information regarding corrosion risks, the City could have taken action much sooner to address the issue. Mr. Glasgow stated in deposition (Glasgow 2020, p. 649 L21-p.650 L7):

*[Question]: ...isn't it clear that Veolia did not give you the kind of warning you would have expected an expert engineer to give about the impact of not having corrosion control?*

*[Answer, Glasgow]: I can agree with that.*

Mr. Glasgow then went on to describe what they would have done with that type of information from Veolia (Glasgow 2020, P. 649 L2-8):

*[Question]: If you had gotten that kind of warning in any way, shape, or form, whether orally or by a presentation, would you have done anything with it?*

*[Answer, Glasgow]: Yes, I would have.*

*[Question]: What would your normal practice have been?*

*[Answer, Glasgow]: Normal practice would be to grab my supervisor and have a frank discussion with them about what needs to be done.*

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## 8.2 Professional Responsibilities of Veolia

It is standard engineering practice that engineering consultants provide municipalities, such as, the City of Flint, with state-of-the-art, unbiased engineering science and technology. Environmental engineering consultants are supposed to ensure that the client maintains an appropriate measure of compliance with environmental regulations, such as, the Drinking Water Standards and/or the Lead and Copper Rule.

An environmental engineering consultant needs to have the scientific knowledge and technical expertise to conduct thorough environmental assessments. Environmental engineering consultants conduct both field and desk-based research, and will develop completed and detailed scientific reports. The reports should be written in a manner that can be understood by non-technical people. Their research will identify whether water chemistry and contaminants will have an adverse impact on people, materials or the environment. They will interpret data, including detailed in-depth assessment of the data, sometimes using software-modelling packages to see whether existing contamination can be managed to meet current regulations and to minimize impacts to human health.

The Standard of Care for engineers is simple and straight forward, namely: ordinary and reasonable skill (care) usually exercised by one in the profession, on the same type or project, at the same time and in the same place, under similar circumstances and conditions. This means that an engineer is obligated to meet the same quality of work and best engineering judgment that is required of others in their profession. Veolia did not meet the standard of care for the citizens of Flint.

Professional environmental (civil) engineers also perform under the ethics guidance of the American Society of Civil Engineers (ASCE) and the National Society of Professional Engineers (NSPE). The foremost guidance of both of these ethics code is exemplified in the NSPE Pledge shown below:

I pledge:

To give the utmost of performance;  
To participate in none but honest enterprise;  
To live and work according to the laws of man and the  
highest standards of professional conduct;  
To place service before profit, the honor and standing of  
the profession before personal advantage, and the public  
welfare above all other considerations.

Further, engineers in the fulfillment of their professional duties, shall:

1. Hold paramount the safety, health, and welfare of the public in the performance of its professional duties
2. Perform services only in areas of their competence
3. Issue public statements only in an objective and truthful manner
4. Act in professional matters for each employer or client as faithful agents or trustees
5. Avoid deceptive acts in the solicitation of professional employment

Clearly, engineering consultants are held to a standard that requires putting the public welfare first.

This point is further illustrated in Case No. 20-04 of the NSPE issued on 7/1/21. This exemplar involves overruling of the opinions of two professional engineers by the director of a water authority regarding the changing of a water source. In the hypothetical presented by the NSPE (Plaintiff Exhibit 5018 from Bellwether Trial I), the engineers recommended that the switch in water sources be substantially delayed

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until proper corrosion control could be installed due to concerns over the leaching of lead into the drinking water, but they were overruled by the water manager.

The NSPE concluded as follows: (it should be noted that the State of Michigan has formally adopted the NSPE code of ethics as of September 2021):

- 1) In fulfillment of their ethical obligations under the Code, Engineers A and B should formally communicate their concerns to the water manager, including that they believe the project will not be successful (successful being defined by the NSPE as “the public will not be endangered at all.”)
- 2) Both engineers A and B have ethical obligations to notify the water manager and other appropriate authorities that prematurely changing the water sources puts the public health and safety at risk. Furthermore, Engineers A and B have independent obligations to formally and in writing report their concerns to the state regulatory agency. While they may provide a joint and cooperative report, each has an independent obligation. Neither the consent nor opposition of the client is a factor in the fulfillment of this obligation.

Clearly both LAN, Veolia and their engineers failed to meet their ethical obligations along the path that led to the Flint Water Crisis by not making independent statements to the regulatory authorities of their concerns for the health and welfare of the citizens of Flint due to the poor water quality they were receiving.

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## 9 Failures by Veolia to Meet the Standard of Care Applicable to Professional Engineers

### 9.1 Veolia failed to meet the standards of care applicable to professional engineers

Veolia failed to meet the standard of care for professional engineers in multiple ways during their work in Flint. Veolia was the internationally recognized water treatment specialist that dominates capturing approximately 40 percent of the business in their sector, and they had been retained to provide an independent third-party review for the City regarding the issues following the switch from DWSD to treated Flint River water. Veolia failed to identify the presence of highly corrosive water or note the urgency of the need for corrosion control treatment to protect public health and property. Veolia failed to assess the possible impacts that corrosive water could have on the health of the residents, which would occur due to lead in the City's drinking water caused by the absence of corrosion control treatment.

Veolia failed to inform the City in writing (if they provided the City with such advice at all) that although the MDEQ was not requiring corrosion control, the City was in clear violation of Federal regulations under the LCR requiring such. Veolia staff were aware of these requirements (Gnagy 2019, p. 280 L. 4-8). Best engineering practices required that the City be informed via written documentation that they were in violation of Federal Regulations and were putting at risk the health of the public and the plumbing systems. Engineering work performed by Veolia directly contributed to, and at a minimum allowed for, the destruction of piping systems throughout Flint, microbial contamination in the distribution system, and exposure of the citizens of Flint to high concentrations of lead.

### 9.2 Veolia failed to identify enormous risks to human health and property posed by treating and distributing the Flint River water

When Veolia started working in Flint in February 2015, Flint had already received water quality violations from MDEQ regarding the failure to meet the requirements of Total Coliform Rule and the disinfection byproduct standards (for running average TTHMs) resulting in public boil water notices. As Veolia knew, there were also widespread consumer complaints of red water problems and water main breakage throughout the City. (Veolia 2015a, Slide 5 & 20).

The primary Veolia engineers on the Flint project, Mr. Gnagy and Mr. Chen, were aware of many, if not all of the issues facing Flint even before their first day on the job, as evidenced in Mr. Chen's email following the project kick-off (Gnagy Exhibit 6, p. 2-3). In his own meeting notes, Mr. Gnagy suggests that based on a short review of the water quality data that the water in Flint could be corrosive (Gnagy Exhibit 12, p.8), and states that he suggested to City officials that they may have problems with corrosive water (Gnagy 2019, p. 181 L 23-p. 182 L3) — yet Veolia failed to address these issues in their report or recommendations to the City.

In an email exchange between Veolia's Nicholas and Gnagy dating back to February 9<sup>th</sup>, 2015, Veolia admitted internally that "[l]ead seems to be a problem" (Gnagy 2019, Exhibit 10, p.1), yet Veolia failed to effectively warn the public or the City about potential problems with lead resulting from corrosive water. While Veolia has claimed at times that their work was focused on disinfection byproduct issues, Veolia clearly presented themselves as addressing a much larger scope as discussed above. Veolia ultimately failed to identify the risk that the corrosive water and lack of corrosion control posed to the human health and property.

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### 9.3 Veolia did not identify, calculate, or appreciate the significance of the CSMR results that showed that the treated Flint Water was highly corrosive to lead containing materials

Veolia received the data required to perform a CSMR calculation from at least two sources (and could have easily obtained the data from Flint if they had requested it), but still failed to perform the calculations (Gnagy 2019, Exhibits 11 & 12). On February 11th, 2015 Gnagy was provided with comprehensive water testing performed at fifteen locations at the University of Michigan Flint which included chloride, sulfate, lead and copper data (Gnagy Exhibit 11). Gnagy testified that the data from University of Michigan-Flint is not representative of the distribution system (Gnagy Volume I, P. 234), which is simply incorrect. These data should have been used, at a minimum, to calculate a CSMR. The data collected at University of Michigan-Flint should have indicated to Veolia staff that there were issues with corrosive water and lead in the drinking water, which needed to be investigated further. As example of this University of Michigan data and the concerning information it contained, Sample Site #4 (from a drinking fountain) had a lead concentration of 29 µg/L (almost double the Action Level for lead) and a CSMR of 2.4 equating to a significant concern for corrosion.

So not only did Gnagy fail to insist on getting all of the results from the UM-Flint testing, but he didn't even recognize data of significant importance in the incomplete testing results he did obtain.

Gnagy was also provided plant data for the raw and treated Flint River water data on February 18<sup>th</sup>, 2015 (Gnagy Exhibit 12). That data was for December and August 2014 and included chloride and sulfate, and the title of the hand written notes was Corrosion Control Checking 2/18/2015. Gnagy calculated a Langelier Saturation Index value (LI on the Gnagy notes), but did not calculate a CSMR. The Langelier saturation index values calculated by Gnagy (-0.12 and -0.17) indicate that the water was undersaturated with respect to calcium carbonate, and had a tendency to dissolve calcium carbonate scales, which may have been protective from a corrosion standpoint. A further investigation into the issue would have indicated the Langelier Saturation Index frequently was lower (ranging as low as -1.2, Masten 2016), indicating even more undersaturated conditions with regards to calcium carbonate.

If Gnagy had calculated the CSMR values using the data provided in his notes, he would have found a CSMR of 3.3 and 6.3. These CSMR level are characterized as a significant or serious concern for high lead corrosivity depending on the alkalinity (Masten 2016, Nguyen 2010), and were an obvious red flag that there was corrosive water being introduced into the drinking water system in Flint. This corrosive water, as indicated by the CSMR was an obvious sign that there were concerns for lead release into the water.

In Gnagy's notes from February 18th 2015, he goes on to note that (Gnagy Exhibit 12, Page 8; Glasgow Exhibit 9):

*\* Corrosive water conditions exist  
discussed w/ plant staff and suggested  
potential issues with lead and copper  
monitoring in the future. Might  
need to balance pH and corrosion  
control with THM compliance issues.*

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Even though Gnagy didn't calculate the CSMR, he was clearly aware that there were potential corrosion problems in Flint. Veolia had a professional obligation to flag these issues in their presentations and reports, but they never did so. A hand-written note and an off-the-record comment to unknown plant staff is wholly inappropriate and well below the standard of care. The corrosion problems in Flint damaged property and exposed the residents to lead. Not performing further investigations into corrosion, or even simple calculations to confirm the risks, was below the engineering Standard of Care as Veolia's engineers did not "hold paramount the safety, health, and welfare of the public" per the NSPE Code of Ethics.

#### 9.4 LAN and Veolia failed to recommend that immediately switching back to Detroit water and/or issuing a "do not drink" warning to protect the citizens of Flint given then-current water conditions

Returning to DWSD water would have helped to curb many of the ongoing issues related to corrosion and disinfection by products that resulted from treating the Flint River water. In an email from Veolia's Mr. Nasuta to Mr. Gnagy and Mr. Chen at the start of the project, he stated as follows (Chen, 2019, Exhibit 3, p. 1-2):

*According to the news at this time - DWSD has just offered to reconnect the DWSD supply line to Flint with no strings attached (no re-connection fee, no long term contract). Many residents are asking to have the DWSD water back (until the new pipeline is ready, including some council members...*

*It seems that reconnecting to the DWSD for the next two years will be the best solution to satisfy the residents and activists.*

Mr. Chen was correct. In his deposition testimony, Mr. Chen discussed his belief at the time the email was sent, that returning to DWSD was "from a technical point of view ... the best technical solution" (Chen, 2019, p. 84 L15-16). When asked why he recommended changing back to DWSD, Mr. Chen stated that "the source water is better, the product water will be better. And the citizens demand that. I mean they will only be happy if you reconnect to the city – the DWSD water" (Chen 2019, p. 85 L8-12).

Mr. Nasuta, also in the technical department at Veolia, stated that (Gnagy 2019, Exhibit 13):

*Talked with Mr. Fahey "and he made it 'very clear' the technical group needs to point out that the quickest and maybe safest option is to return to Detroit water. We can say that we have not evaluated the cost impacts of that option, if we have not, but we need to tell [Business Development] that this is an option and [it is] quick to implement.*

*I'm not sure what documents, email or your role in any presentation is but please in some form (report paragraph or email best) tell BD that returning to Detroit is an option. If they want to throw that out and not bring it up, that is up to them but we need to be sure to tell them the obvious; there is a quick an [sic] easy fix to this (even if it is not in the scope of work BD asked to look at).*

Returning to DWSD water was the correct, logical, and easiest option just as it was when the system returned to DWSD water in October 2015. However, Veolia never recommended that the City switch back to DWSD water. Internally, the technical team had the following exchange on the subject of reconnection to DWSD (Fahey, 2019, Exhibit 24):

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**From:** Nasuta, Joseph [joseph.nasuta@veolia.com]  
**Sent:** Friday, February 13, 2015 2:30 PM  
**To:** Marvin Gnagy; Depin (Theping) Chen  
**Subject:** Flint

See the attached comment for Fahey regarding Flint. I think there are some issues at the corp BD level on this but we need to look at it from the technical end only (as we always do). Please keep this between us.

On the Flint MI project that Marvin is working on. If the best "technical decision is to go back to the City of Detroit as its supplier" we should not be afraid to make that call. Just make sure that the politics of this should not get in the way of making the best recommendation.

jtn

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Joseph T. Nasuta, PE  
Director, Optimization  
Municipal & Commercial Business  
VEOLIA NORTH AMERICA

Despite the Veolia team's clear internal recognition that switching back to Detroit was the best course of action, the recommendation for a reconnection to DWSD was not included in any of the reports or presentations made by Veolia. Instead of making that technically sound recommendation, Veolia gave in to their own self-interests with regards to additional work with the City of Flint.

Mr. Chen notes that on three instances, the City informed Veolia that going back to DWSD was not an option.

In one such instance, during a meeting with the City Emergency Manager, Mr. Ambrose (Chen, 2019 p. 99 L15-18):

*March 18, the public meeting, yeah, I heard Mr. Ambrose said [sic] in person that, you know, they're not going to go back [to DWSD] and it's not an option.*

Veolia faced a conflict of interest. A recommendation to return to DWSD would eliminate their opportunity for potential additional work with Flint (recall that engineers are obligated to put public health above profit by the Pledge of the NSPE and common engineering ethics). As stated by Mr. Nicholas, a Veolia Vice President in Business Development (BP) in an email to Mr. Fahey (Nicholas 2019, Exhibit 5):

*The current intent is to get paid to do a week on site investigation to be clear what is going on, is it fixable and what we would need. That information would be used for defining the scope going forward. The ultimate focus is not on the water problem but fixing the entire utility. It is a great PPS, Delegated Management or O&M possibility. The water loss is 50% plus and there are problems on the waste water side as well.*

The business case was similarly laid out in the pre-project Go/No-Go internal evaluation memo (Fahey, Exhibit 7). Veolia ultimately did not present reconnecting to the DWSD system as an option in their presentations or in their reports that to the City and the public. By making this decision, Veolia violated three of the engineering standard of care requirements.

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- *Engineers “shall hold paramount the safety, health and welfare of the public” (ASCE Code of Ethics, Canon 1)*
- *“Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest” (ASCE Code of Ethics, Canon 4)*
- *Protecting the public from harm must prevail over business and political considerations*

Connecting to the DWSD system would have resulted in a fast and effective change to a proven, and safe water source treated for corrosion control. Veolia failed to disclose their internal conflict of interest and bent to their own self-interests to provide an engineering option that was not effective in the larger context of the water system. Veolia put their business interests ahead of the needs of the public. In doing so, Veolia contributed to continued degradation of the health of the residents of Flint, and the continued exposure of the residents to drinking water with elevated concentrations of lead.

#### 9.5 Veolia’s reports downplayed the corrosion issues as “aesthetic issues” and failed to warn the City and its residents of substantial dangers

Veolia repeatedly downplayed the problems of corrosion through the water system in their presentations and public reports. Veolia was aware that what they told the City staff and officials must also be communicated to the public (Gnagy 2019, p. 65 L6-9) and did a public presentation (Gnagy 2019, p. 65 L 13-15). Downplaying the corrosion issues as aesthetic issues was a not only a disservice to the public and was not protective of the public’s property nor of their health, the substance and shallowness of the recommendation was not consistent with the accepted engineering standard of care.

In Veolia’s February 18th, 2015 presentation to the City of Flint Public Works Committee, Veolia defines safe water as follows (VNA 2015a, p. 3):

- *Safe = compliance with state and federal standards and required testing*
  - *Latest testing shows water is in compliance with drinking water standards*
  - *Monthly reports are available on web page*

The drinking water in Flint was clearly not safe, yet Veolia presents it as such in their presentation, thereby marginalizing the critical risks this water presented to health and the plumbing systems. Veolia hadn’t performed tests on the water at this time, but there were red flags related to the water quality including the presence of lead in the University of Michigan-Flint sampling data as discussed above. The water contained high concentrations of THMs, and as a result of the corrosion issues the water was both reddish in color and contained high concentrations of lead. The Flint River water was also corroding residents piping systems at an accelerated rate and introducing high levels of lead from the dissolution of the lead phosphate pipe scales which still remain in the steel pipes to this day.

Regarding the discolored water, Veolia blamed the red water on “old cast iron pipes,” and stated that there “always has been some discolored water problems – mostly after water breaks” (Veolia 2015a, p. 5), and even claiming that the discoloration has been caused at times by “air built up [sic]” (Veolia 2015a, p. 20). In their final report, Veolia claims that (Veolia, 2015b, p. 11):

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- **Discolored Water** – The discolored water is caused by the old unlined cast iron pipe. The water from the plant can have an impact on discolored water, but a greater concern is the breaks and construction work that disrupt the flow of water causing discoloration. A polyphosphate is suggested to help bind the old cast iron pipe reducing instances of discolored water. This along with improve flow of water and programmed hydrant flushing will help, BUT WILL NOT eliminate discolored water occurrences.

Veolia addresses the red water as an aesthetic issue, and not as a serious corrosion issue. Their recommendation was to dose polyphosphate to mask the red water issues. Polyphosphate is a chemical that reduces the red appearance of the water, while at the same time increasing corrosion rates. Therefore, the addition of polyphosphates likely would have worsened the situation in Flint with regards to corrosion and lead. Veolia presents the red water issue as something minor, instead of a red flag of the magnitude of the corrosion problems in Flint. In doing so, Veolia was ignoring the obvious risks of a water system with iron, copper (with high lead and copper), and lead pipes without corrosion control.

Veolia violated the engineering standard of care by failing to warn the City and its residents of the substantial dangers that the corrosive water presented. The water was in fact not safe, even though Veolia presented it is as such, thereby endangering the public and violating the standard of care.

#### 9.6 Veolia falsely minimized its roles and responsibilities and falsely claimed that lead and corrosion issues were outside the scope of its work.

On Veolia's website (veoliaflintfacts.com), they falsely claim that in Flint they had a limited scope of Work (although recall that Mr. Nicholas stated that their contract was "paid due diligence" implying that the cost did not matter) and that lead and corrosion issues fell outside of their scope of work. In contrast to those claims, the lead engineer on the project for Veolia said "if we identify an issue that needs to be brought to [the client's] attention, we report it to them" (Gnagy 2019, p. 96 L 20-24).

Yet Veolia never formally documented these concerns or conveyed them to the public or the City. There is no record of Veolia expressing concerns about the corrosion problems or unsafe water to the City or the public. Veolia was obligated to memorialize their observations and analyses into their reports, yet they didn't do so. Where is the Veolia report that conveyed even the small level of information found in the SEG on operations or the TYJT report on the switch from DWSD to Flint to KWA? The answer is it doesn't exist.

Veolia could have provided an equally competent report to the TYJT report. Instead, Veolia did not invest the effort and were more worried about their business opportunities than the health and welfare of the Flint residents.

#### 9.7 Veolia failed to notify the MDEQ and the City of its belief that it was a mistake to start operations of the FWTP without corrosion controls and that such controls were required by all applicable standards of care.

It must have been patently obvious to the Veolia engineers that during their one week on site to scope things out, that the treatment plant and its operators were incapable of consistent and safe operations, even after ten months of operations (Nicholas 2019, Exhibit 5). The plant was old and did not have an operable central operations center (no useable SCADA). The equipment was unreliable and was marginally functional. The treatment plant did not utilize corrosion control, and the ferric chloride utilized as a

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coagulant was contributing the corrosive tendencies present in the Flint River water. In fact, Veolia failed to consider changing coagulants, such as to alum, which would have decreased the CSMR and thereby the corrosivity of the water. Lead leaching from plumbing systems has been shown to be sensitive to the coagulant used.

As stated by Professor Edwards (Edwards and Triantafyllidou 2007):

*Preliminary data and theory suggest that lead leaching is most sensitive to coagulant type in treating waters with relatively low Cl<sup>-</sup> and SO<sub>4</sub><sup>2-</sup>, because potential shifts in CSMR are more significant in these situations. Lower alkalinity might also be an important factor, because a low buffering capacity is expected to increase the magnitude of the pH drop at the lead anode. While the water from the Flint River had chlorides, the result was of the addition of ferric chloride as a coagulant increased the CSMR and contributed to the corrosivity and lead leaching. The soft Flint River water also periodically experienced low alkalinity, which further impacted the lead in the plumbing systems.*

In 2015, when Veolia arrived on site, they had to have seen the poor level of operation and maintenance by operators who were lacking in skill and training, including the Chief Plant Operator, Mike Glasgow, who indicated that he had only a few days of hands-on operational experience. Mr. Glasgow knew the plant and its operators were not ready to adequately treat the water for distribution. Why didn't Veolia's trained water treatment professionals know that? Mr. Glasgow himself indicated that if they started the plant in April of 2014 as the sole source of drinking water for Flint it would be without his support (Glasgow 2020, Exhibit 24).

Mr. Glasgow's reservations and insecurities regarding premature start up were borne out to be completely true. The plant performed poorly exhibiting wild spikes in pH, alkalinity, and hardness due to poor quality treatment and a lack of process control. With a high-quality water source, the Flint operators might have gotten away with their errors, but with the Flint River quality, the fate of the operation was predetermined to fail. Veolia had an obligation to report on these problems to the regulators and to city officials. Veolia operates water treatment plants across the United States. Their technical team was aware that the change in water source should have required a corrosion control study.

Gnagy stated as such (Gnagy, 2019, P. 37 L 14-24):

*I've already stated DEQ told Flint they did not have to do additional corrosion control treatment. In my opinion that is in violation of the Lead and Copper Rule, because if you make any significant change to source water or treatment, you have to do, under the Lead and Copper Rule, a comprehensive corrosion control study to implement corrosion control as part of the treatment process. That was not done, and DEQ told them they did not need to do it.*

With that knowledge, Veolia had an obligation to recommend that a corrosion control study be performed and that immediate actions be taken to address, or at least evaluate, possible problems with corrosion. Instead Veolia downplayed the corrosion issue and made minimal references to corrosion control in their reports and public presentations.

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- 9.8 Veolia violated its ethical obligations by placing its economic interests ahead of its obligations to safeguard the public by not disclosing its interest in obtaining a lucrative operating contract and by actively supporting inappropriate decisions by public officials whom it knew were motivated solely by financial concerns but who were also the decision makers on the operating contract it sought.

This issue is fully supported by the numerous internal memos and emails of the Veolia principals and Engineers. In general, this project was driven by the manager of Veolia business development (BD), Mr. Nicholas, who overrode the more technical team, who made it clear that the job that Flint needed was not Veolia's kind of job, and that Veolia was not prepared to present an analysis addressing the significant issues in Flint, such as, those causing the lead exposure in Flint.

Veolia management should have addressed their ethical responsibility to the City and its residents. Instead, Mr. Nicholas (who guidance was questioned repeatedly in internal Veolia emails such as, "*BD seems to be running the show. Not sure why*" [Gnagy 2019 p.263 L 4-5]) was the senior person for Veolia on this project. This unusual approach was undoubtedly driven by Veolia's desire to secure a large-scale operations or management project in Flint. This intent was made clear in numerous internal correspondences including the initial go-no go memo analyzing the business opportunity. It is crystal clear that if the City had asked Veolia to take over operations of the water treatment plant (a privatization step that they specialize in), Veolia would have gladly explained what was needed to make the plant reliable and able to produce safe drinking water, before the plant could be used to treat the City's drinking water. However, instead of either refusing the contract for this project (they were the sole firm who responded to the City's RFP – which was on their minds as to why that was the case [Gnagy 2019 Exhibit 6, p. 1-2]).

Veolia moved forward with the hope of future work. Veolia never provided the City with engineering and/or best engineering judgement (BEJ). Veolia was obligated both ethically and professionally to conduct an unbiased and conflict of interest free third-party review of the problems in Flint. Of course the City eventually followed Veolia's intuition to return to the DWSD water source immediately, which is an opinion that Veolia never communicated to the City in writing).

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## 10 Materials Reviewed

AB&H, 2002. Treatability Study: Flint River. LAN FLINT 00040694-00040785.

AECOM, Jones & Henry Engineers LTD, LAN, O'Malia Consulting, ROWE, Wade Trim Inc. Preliminary Engineering Report: Lake Huron Water Supply: Karegnondi Water Authority. September 2009.

Adeosun, O.O., 2014. Water Distribution System Challenges and Solutions. Water Online, September 9, 2014.

Arnold Jr, R.B., Griffin, A., and Edwards, M., 2012. Controlling Copper Corrosion in New Construction by Organic Matter Removal. Journal-American Water Works Association, 104(5), E310-E317.

Arnold, R.B., Rosenfeldt, B., Rhoades, J., Owen, C., and Becker, W., 2020. Evolving Utility Practices and Experiences with Corrosion Control. Journal-American Water Works Association, 112(7), 26-40.

AWWA, 2005. Managing Change and Unintended Consequences: Lead and Copper Rule Corrosion Control Treatment. American Water Works Association.

American Water Works Association (AWWA), 1940. Manual of Water Quality and Treatment. AWWA, New York, N.Y., First Edition-Second Printing, 1941.

AWWA, 2017. Internal Corrosion Control in Water Distribution Systems, 2nd Edition. AWWA, 2017: M58.

Bae, Y., and D. Giammar., 2019. Processes Controlling the Development of Effective Lead Corrosion Control with Orthophosphate. WRF, 2019.

Bellamy, W., 2021. Declaration of William Bellamy, Ph.D., P.E., BCEE. In Re Flint Water Cases, U.S. District Court of the Eastern District of Michigan, Civil Action 5:16-cv-10444-JEL-MKM, January 6, 2021.

Bellamy, 2022a. Trial Testimony of William Bellamy, Case No. 5:17-cv-10164-JEL-KGA. June 28, 2022.

Bellamy, 2022b. Trial PowerPoint Presentation of William Bellamy, Case No. 5:17-cv-10164-JEL-KGA. June 28, 2022.

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Bithoney, 2022c. Trial Testimony of William Bithoney, Case No. 5:17-cv-10164-JEL-KGA. May 16, 31; June 1, 2022.

Bithoney, 2022d. Trial PowerPoint Presentation of William Bithoney, Case No. 5:17-cv-10164-JEL-KGA. May 16, 31; June 1, 2022.

Bithoney, 2022e. Geo-mapping report of William Bithoney, Case No. 5:17-cv-10164-JEL-KGA. Presented at trial, May 16, 31; June 1, 2022.

Brown, Richard A., N.E. McTibure and D.A. Cornwell, 2013. Strategies for assessing optimized corrosion control of lead and copper. JAWWA 105:5 page 62

Cantor, A. F., et al., 2006. Copper Pipe Failure by Microbially Influenced Corrosion. Materials Performance, June 2006 p. 38-41.

Chen, 2019. Deposition of Depin (Theping) Chen, Volumes I and II; Case No. 5:16-cv-10444. November 25-26, 2019.

City of Flint, 2013. Resolution Authorizing Change Order #2 to the Lockwood, Andrews & Newman Contract for the Implementation of Water Plant Operations. November 18, 2013.

City of Flint, 2014. Annual Water Quality Report. City of Flint Michigan.

City of Flint, 2015. Resolution to Veolia Water for Water Quality Consultant. February 4, 2015.

City of Flint, 2018. Annual Water Quality Report. City of Flint Michigan.

City of Flint, 2021. Wastewater treatment plant monthly operation reports (MORs), 2010-2020.

City of Flint, 2013a. Change Oder #2 t the LAN contract. November 18th, 2013.

City of Flint, 2013b. Contract with LAN. June 26th, 2013.

Clark, B., S. Masters, and M. Edwards, 2014. Profile Sampling to Characterize Particulate Lead Risks in Potable Water. Environmental Science and Technology 2014, 48, 6836-6843.

Clark, B. N., S. V. Masters, and M. A. Edwards. Lead Release to Drinking Water from Galvanized Steel Pipe Coatings. Environmental Engineering Science, Aug 2015, 713-721.

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Del Toral, M., 2015. High Lead Levels in Flint, Michigan – Interim Report. USEPA, Region 5, June 24, 2015.

DeSantis, M. K., et al., 2018. Mineralogical Evidence of Galvanic Corrosion in Drinking Water Lead Pipe Joints. Environmental Science and Technology, 2018 March, 52(6):3365-3374.

Detroit Water and Sewerage Department, 2014. Water Quality Report. Published 2015.

Detroit Water and Sewerage Department, 2015. Water Quality Report. Published 2016.

Detroit Water and Sewerage Department (DWSD), Volume 1 and 2 and Executive Summary, 1994. Lead and Copper Corrosion Control Optimization Study. Prepared by Tucker, Young, Jackson, Tull, inc. in association with CH2M Hill, Inc., and Economic and Engineering Services, Inc.

Duquette, D., 2021. Declaration of David Duquette, Ph.D. In Re Flint Water Cases, U.S. District Court of the Eastern District of Michigan, Civil Action 5:16-cv-10444-JEL-MKM, January 6, 2021.

Edwards, M. and S. Triantafyllidou, 2007. Chloride-to-Sulfate Mass Ratio and Lead Leaching in Water. J. of the American Water Works Association, Volume 99, Issue 7, p. 96-109.

Edwards, M., 2015. Research Update: Corrosivity of Flint Water to Iron Pipes in the City — A Costly Problem. Flintwaterstudy.org, September 29, 2015.

Edwards, M., McNiell, L.S., 2002. Effect of phosphate inhibitors on lead release from pipes. AWWA 94:1, pp.79-90, January 2002.

Edwards, M. McNeill, L.S., Holm, T.R., Lawrence, M.C., 2001. Role of Phosphate Inhibitors in Mitigating Lead and Copper Corrosion. AWWA Research Foundation & AWWA.

Edwards, M., S. Roy, and W. Rhoads, 2015. Lead testing results for water sampled by residents. Flintwaterstudy.org, September 2015.

Einstein, H.A., 1950. The Bed-Load Function for Sediment Transportation in Open Channel Flows. U.S. Department of Agriculture, 1950, p.71

EPA, 2006. Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems. USEPA, Office of Water, EPA 816-B-16-003, March 2016.

Fahey, W. J. 2019. Deposition of William J. Fayhey, Volumes I & II; Case No. 5:16-cv-10444. December 3-4, 2019.

Expert Report of Dr. Larry L. Russell  
January 3<sup>rd</sup>, 2023

Fahey, 2022. Trial Testimony of William Fahey, Case No. 5:17-cv-10164-JEL-KGA. June 7-8, 2022.

FlintGIS, 2016. Maps and parcel data for 2016 provided by FlintGIS, City of Flint Department of Planning and Development.

Gadis, D. 2020. Deposition of David Gadis, Volumes I & II; Case Nos. 5:16-cv-10444, 17-108644-NO, 16-106150-NM. January 30-31, 2020.

Gagnon, 2022. Trial Testimony of Graham Gagnon, Case No. 5:17-cv-10164-JEL-KGA. June 13-16, 2022.

Gagnon, G., 2021. Declaration of Graham Gagnon, Ph.D., P.Eng. In Re Flint Water Cases, U.S. District Court of the Eastern District of Michigan, Civil Action 5:16-cv-10444-JEL-MKM, January 6, 2021.

Gagnon, G., 2020. *Expert Report of Graham Gagnon, Ph.D., P.Eng.*, Civil Action No. 5:17-cv-10164-JEL-MKM, November 25, 2020.

Glasgow, 2020. Deposition of Michael B. Glasgow, Volumes I, II, and III; Case No. 5:16-cv-10444. February 24-26, 2020.

Gnagy, 2019. Deposition of Marvin Gnagy, Volumes I and II; Case No. 5:16-cv-10444. December 12-13, 2019.

Goovaerts, P. 2017a. The Drinking Water Contamination Crisis in Flint: Modeling Temporal Trends of Lead Levels Since Returning to Detroit Water System. *Science of the Total Environment*, 581-582:66.

Goovaerts, P., 2017b. Monitoring the Aftermath of Flint Drinking Water Contamination Crisis: Another Case of Sampling Bias. *Science of the Total Environment*, 590-591:139.

Goovaerts, P., 2017c. How Geostatistics Can Help you Find Lead and Galvanized Water Service Lines: The Case of Flint, MI. *Science of the Total Environment*, 599-600 (2017) 1552-1563.

Green, W. Witness testimony of John Warren Green, D.C. File Nos. 16-TA-327-FY, 16TB-927-FY, 16-TB-1685-FY, 16TC-1685-FY.

Green, W., 2020. Deposition of Warren Green, Rough Draft Transcript. June 25-26 & 28, 2020.

Gamble, R. B., 2020. Expert Report of R. Bruce Gamble. Ankura Consulting Group LLC, June, 2020

Expert Report of Dr. Larry L. Russell  
January 3<sup>rd</sup>, 2023

Gardoni, P., 2020. Expert Report of Dr. Paolo Gardoni, Flint Plaintiffs Class Action Certification. June, 26, 2020.

Gnagy, 2022. Trial Testimony of Marvin Gnagy, Case No. 5:17-cv-10164-JEL-KGA. June 8-9, 2022.

Great Lakes Water Authority (GLWA), 2016. Corrosion Control and Water Testing: Response to Frequently Asked Questions about Lead and Copper in Water. June 2016.

Hagerty, K., 2020. Deposition of Kevin Hagerty; Case No.

Hoaglund, J.R., 2019. Expert Report of Dr. John R. Hoaglund, III Ph.D., August 10, 2019.

Holm, T.R. and Schock, M.R., 1991. Potential effects of polyphosphate products on lead solubility in plumbing systems. JAWWA, Res. And Tech. Vol 83, 7:76-82.

Humann R.W., 2020. Expert Report of Richard W. Humann, P.E., August 10, 2020.

Humann, 2022. Trial Testimony of Richard Humann, Case No. 5:17-cv-10164-JEL-KGA. May 4-9, 2022.

Kirkmeyer, G. Contribution of Service Line and Plumbing Fixtures to Lead and Copper Rule Compliance Issues. Report Number 3018 AWWA RF 2008 91.

LAN and ROWE, 2011. Analysis of the Flint River as a Permanent Water Supply for the City of Flint. July 2011.

LAN, 2011. *Technical Memorandum: Cost of Services Study Flint Water Treatment Plant*. Plaintiff's Exhibit 3894-003, LAN\_FLINT 00205692-00205704.

LAN 2013. Proposal: Flint Water Treatment Plant Habilitation – Phase II. June 10, 2013.

LAN and ROWE, 2013. Proposed Scope of Upgrades to Flint WTP. August 20, 2013.

LAN 2015a. Operational Evaluation Report, City of Flint: Trihalomethane Formation Concern; FINAL. February 27, 2015.

LAN, 2015b; Operational Evaluation Report, City of Flint: Trihalomethane Formation Concern; FINAL: Response to May 2015 Sample Results. August 27, 2015.

Expert Report of Dr. Larry L. Russell  
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LAN 2016. Response: Flint Water Advisory Task Force Questions to Lockwood, Andrews and Newnam. March 1, 2016.

LAN 2020a. Defendants LAN and LAD Answers to Class Plaintiffs' Interrogatories; Case No: 5:16-10444.

LAN 2020b. Defendants LAN and LAD Second Supplemental Amended Answers to Class Plaintiffs' Interrogatories; Case No: 5:16-10444. April 13, 2020.

Langelier, W.F, 1936. The Analytical Control of Anti-Corrosion Water Treatment. JAWWA 28:10, 1500-1521.

Larson, T. E. and R. V. Skold, 1958. Laboratory Studies Relating Mineral Quality of Water to Corrosion of Steel and Cast Iron. Corrosion, Vol. 14, No. 6, p. 285t-288t.

Larsen, K.R., 2016. Corrosion caused lead-tainted water in Flint, Michigan. Materials Performance, 55(6), 26-29.

Lawler, D.F., Katz, L.E., 2021. Declaration of Desmond F. Lawler, Ph.D. and Lynn E. Katz. Case No. 5:16-cv-10444-JEK-MKM, Exhibit 8, January 7, 2021.

Lawler, D.F., Katz, L.E., 2020. Expert Report of Desmond F. Lawler, Ph.D. and Lynn E. Katz. Case No. 5:16-cv-10444-JEK-MKM, Exhibit 8, November 25, 2020.

Leonardi, J. M, and W. J. Gruhn, 2001. Flint River Assessment. State of Michigan, Department of Natural Resources, July 2001.

Liang, S., et al., 2013. Controlling Chloramine Decay – A Bench-Scale Investigation. Presentation at American Water Works Association Annual Conference, 2013.

Lytle, D.A., M.R. Shock, K. Wait, K. Cahalan, V. Bosscher, A. Porter, M. Del Toral, 2019. Sequential Drinking Water Sampling as a Tool for Evaluating Lead in Flint, Michigan. Water Research, 157 (2019)40-54.

Maddison, L.A., Gagnon, G.A., Eisnor, J.D., 2001. Corrosion Control Strategies for the Halifax Regional Distribution System. Can. J. Civ. Eng. 28: 305-313 (2001).

Markowitz, G., and D. Rosner, 2000. "Cater to Children": The Role of The Lead Industry in a Public Health Tragedy, 1900-1955. American Journal of Public Health, January 2000, Vol. 90, No. 1.

Expert Report of Dr. Larry L. Russell  
January 3<sup>rd</sup>, 2023

Masten et al., 2016. Flint Water Crisis: What Happened and Why? Journal of the American Water Works Association, 108(12) 22-34.

Masten et al., 2019. Lead and Copper Rule and Lead Levels in Flint's Water. Journal of the American Water Works Association, September 2019, Vol 111, No. 9.

McFadden, M., R. Giani, P. Kwan, & S.H. Reiber, 2011. Contributions to drinking water lead from galvanized iron corrosion scales. Journal of the American Water Works Association, 103(4), 76.

Michigan Dept. of Environmental Quality, 2016. Post-Filter Installation Sampling Results Report – Doyle Ryder Elementary. December 14, 2016.

Michigan Dept. of Environmental Quality, 2016. Post-Filter Installation Sampling Results Report – Freeman Elementary School. October 14, 2016.

Michigan Dept. of Environmental Quality, 2017. Post-Filter Installation Sampling Results Report – Durant Tuuri Mott. January 3, 2017.

Michigan Society of Professional Engineers, 2021. Position Paper – Code of Ethics: Its Value in the Practice of a Licensed Engineer. NSPE-MI, September 2021.

Muytwyk et al., 2014. Developing Corrosion Control for Drinking Water Systems. AWWA Opflow. 2014; 40(11):24.

MWH, 2005. Water Treatment: Principles and Design. John Wiley and Sons.

Nakashima, J., 2020. Deposition of Jeremy Nakashima, Civil Action No. 5:16-cv-10444-JEL-MKM. June 22-23, 2020.

Nasuta, J., 2020. Deposition of Joseph Nasuta, Case Nos. 5:16-10444, 17-108646-NO, 16-106150-NM. December 5, 2020.

Nguyen, C. K., et al., 2010. Impact of Chloride: Sulfate Mass Ratio (CSMR) Changes on Lead Leaching in Potable Water. Water Research Foundation.

Nguyen C., et al, 2010a. Slideshow: Impact of Chloride: Sulfate Mass Ratio (CSMR) Changes on Lead Leaching in Potable Water. Presentation of research funded by USEPA and WRF, Project #4088.

Expert Report of Dr. Larry L. Russell  
January 3<sup>rd</sup>, 2023

Nguyen, C.K., Clark, B.N., Stone, K.R., and Edwards, M.A., 2011. CORROSION (2011) 67 (6): 065005-1–065005-9.

Nguyen, C. K., K. R. Stone, M. A. Edwards, 2011. Chloride-to-sulfate mass ratio: Practical studies in galvanic corrosion of lead solder. Journal AWWA: 103:1. January 2011.

Nicholas, R. T., 2019. Deposition of Robert T. Nicholas, Volumes I & II; Case Nos. 5:16-10444, 17-108646-NO, 16-106150-NM. December 9 & 11, 2020.

NSPE Board of Ethical Review, 2020. Case No. 20-04, Public Health, Safety, and Welfare – Drinking Water Quality. 2020.

Pavwoski, 2020. Deposition of Mark Pavwoski; Case No. 5:16-cv-10444. February 27, 2020.

Pieper, K. J, et al., 2018. Evaluating Water Lead Levels During the Flint Water Crisis. Environmental Science & Technology, 2018, 52, 8124-8132.

Pieper, K. J, M. Tang, and M. A. Edwards, 2017. Flint Water Crisis Caused by Interrupted Corrosion Control: Investigating “Ground Zero” Home. Environmental Science and Technology. 2017, 51, p. 2007-2014.

Plaintiff’s Exhibit 0206, Case No. 5:17-cv-10164-JEL-KGA. VWNAOS005285- VWNAOS005287.

Plaintiff’s Exhibit 0042, Case No. 5:17-cv-10164-JEL-KGA . VWNAOS081161

Plaintiff’s Exhibit 0050, Case No. 5:17-cv-10164-JEL-KGA . VWNAOS081088 with attachment.

Plaintiff’s Exhibit 0054, Case No. 5:17-cv-10164-JEL-KGA. VWNAOS005704- VWNAOS005707.

Plaintiff’s Exhibit 0213, Case No. 5:17-cv-10164-JEL-KGA. VWNAOS160291- VWNAOS160300.

Plaintiff’s Exhibit 0244, Case No. 5:17-cv-10164-JEL-KGA. VWNAOS008009- VWNAOS008012.

Plaintiff’s Exhibit 0255, Case No. 5:17-cv-10164-JEL-KGA. VWNAVWNAOS79683- VWNAOS079690.

Plaintiff’s Exhibit 0463, Case No. 5:17-cv-10164-JEL-KGA. Feb18MeetingTranscript\_Highlighted, Extracted Text VWNAOS091608.

Plaintiff’s Exhibit 0464, Case No. 5:17-cv-10164-JEL-KGA.VWNAOS0565666- VWNAOS056569.

Plaintiff’s Exhibit 0465, Case No. 5:17-cv-10164-JEL-KGA.VWNAOS056578- VWNAOS056581.

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Plaintiff's Exhibit 0469, Case No. 5:17-cv-10164-JEL-KGA. VWNAOS020165- VWNAOS020187.

Plaintiff's Exhibit 0471, Case No. 5:17-cv-10164-JEL-KGA. VWNAOS007583- VWNAOS007584.

Plaintiff's Exhibit 0478, Case No. 5:17-cv-10164-JEL-KGA. VWNAOS013963- VWNAOS013967.

Plaintiff's Exhibit 3893-025, Case No. 5:17-cv-10164-JEL-KGA. VWNAOS055565- VWNAOS055567.

Pogorilich, D. A., 2020. Expert Report of David A. Pogorilich. Ankura Consulting, LLC, June [ ], 2020.  
Ramaley. Trial Testimony of Brian Ramaley, Case No. 5:17-cv-10164-JEL-KGA. July 19, 2022.

Ramaley, B.L., 1993. Monitoring and Control Experience Under the Lead and Copper Rule. Journal  
AWWA, 1993, Vol. 85, Issue 2, pp.64-67.

Ramaley, B.L., 2021. Declaration of Brian L. Ramaley, P.E. Case No. 5:16-cv-10444-JEK-MKM, Exhibit  
7, January 7, 2021.

Ramaley, B.L., 2021. Expert Report of Brian L. Ramaley, P.E. Case No. 5:16-cv-10444-JEK-MKM,  
Exhibit 7, November 25, 2020.

Reiber, S., Poulosom, S., Perry, S.A.L., Edwards, M., Patel, S. and Dodrill, D.M., 1997. A General  
Framework for Corrosion Control Based on Utility Experience. AWWA Research Foundation and  
AWWA.

Roberge, P., 2006. Corrosion Inspection and Monitoring. Wiley-Interscience.  
ROWE, December 2013; City of Flint Water Reliability Study: Distribution System

Roy, S., and Edwards, M., 2020. Efficacy of Corrosion Control and Pipe Replacement in Reducing City  
Wide Lead Exposure During the Flint, MI Water System Recovery. Environmental Science Water  
Research & Technology, 2020, 6, 3024-3031.

Roy, S., M. Tang, and M. A. Edwards, 2019. Lead Release to Potable Water During the Flint Michigan  
Water Crisis as Revealed by Routine Biosolids Monitoring Data. Water Research, 160 (2019) 475-483.

Russell, L. L., 2016. Declaration in Pulte Homes v. MWD.

Sarver, E., and M. Edwards, 2012. Inhibition of Copper Pitting Corrosion in Aggressive Potable Water.  
International Journal of Corrosion, Volume 2012, Article 857823.

Expert Report of Dr. Larry L. Russell  
January 3<sup>rd</sup>, 2023

Schneider, O.D. et al., 2011. Comparison of Zinc Versus Non-Zinc Corrosion Control of Lead and Copper. Water Research Foundation and EPA.

Schock, M. R. 2020. Deposition of Michal R. Shock, Volumes I & II; Case No. 5:16-cv-104444 & 4:17-cv-11218. May 5-6, 2020.

Scully, J.R., 2016. The Corrosion Crisis in Flint, Michigan: A Call for Improvements in Technology. Nation Academy of Engineers, The Bridge 46:2, pp. 19-29.

Scorsone, E. and N. Bateson, 2011. Long-Term Crisis and Systematic Failure: Taking the Fiscal Stress of America's Older Cities Seriously; Case Study: City of Flint, Michigan. Michigan State University, September 2011.

Sleeping Giant Environmental Consultants (SGEC), LLP, 2016. Final Results of the Flint Surface Water Treatment Plant Evaluation. Eastern Research Group and USEPA Office of Civil Enforcement, April 25-28, 2016. Schock Deposition Exhibit No. 26.

Snell Environmental Group (SEG), Inc. et al. 1998. Preliminary Design, Plans and Proposed Equipment for Rehabilitation of the Flint Water Plant. City of Flint, Michigan, April 10, 1998.

Santucci Jr., R.J. and Scully, J., 2020. The Pervasive Threat of Lead (Pb) in Drinking Water: Unmasking and pursuing scientific factors that govern lead release. PNAS September 22, 2020 117 (38) 23211-23218.

State of Michigan, 2016. Flint Water Advisory Task Force: Final Report. Office of the Governor Rick Snyder, State of Michigan, March 21st 2016.

Stone, K.S., 2010. Chloride Sulfate Mass Ratio (CSMR) and Nitrate Acceleration of Galvanic Lead-Bearing Solder Corrosion. Master's Thesis in Environmental Science & Engineering at Virginia Polytechnical Institute.

Triantafyllidou, S., J. Parks, and M. Edwards, 2007. Lead Particles in Potable Water. Journal of the American Water Works Association. June 2007 99:6 p. 107-117.

Triantafyllidou, S. and M. Edwards, 2012. Lead in Tap Water and in Blood: Implications for Lead Exposure in the United States. Critical Reviews in Environmental Science and Technology, 42:13, 1297-1352.

Trueman, B.F., Krkosek, W.H., and Gagnon, G.A., 2018. Effect of ortho-and polyphosphates on lead speciation in drinking water. Environ. Sci: Water Res. Technol., 2018, 4, 505-512.

Expert Report of Dr. Larry L. Russell  
January 3<sup>rd</sup>, 2023

Tully, J., DeSantis M.K., Schock, M.R., 2018. Water Quality-Pipe Deposit Relationships in Midwestern Lead Pipes. AWWA Wat Sci. 2019; e1127, p. 1-18. December 2018.

USEPA, 2002a. Effects of Water Age on Distribution System Water Quality. USEPA Office of Ground Water and Drinking Water, Office of Water (4601M), August 15, 2002.

USEPA, 2002b. New or Repaired Water Mains. USEPA Office of Ground Water and Drinking Water, Office of Water (4601M), August 15, 2002.

USEPA, 2008. Lead and Copper Rule: A Quick Reference Guide. United States Environmental Protection Agency, EPA 816-F-08-018, June 2008.

USEPA, 2014. Effectiveness of the Preservation Protocol within EPA Method 200.8 for Soluble and Particulate Lead Recovery in Drinking Water. USEPA, August, 2014; EPA/600/F-14/248.

USEPA, 2016. Drinking Water Treatment and Distribution Water Quality During the Water Crisis in Flint. Presentation at AWWA WQTC, Indianapolis, IN. November 2016.

USEPA, 2016a. Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems. USEPA Office of Water (4606M), 816-B-16-003, March 2016.

USEPA & AWWARF, 2008. Contribution of Service Line and Plumbing Fixtures to Lead and Copper Rule Compliance Issues. AWWARF.

USGS, 1963. Water Resources of Flint Area Michigan. United States Geological Survey (USGS), 1499-E, 1963.

USGS, 2016. Potential Corrosivity of Untreated Groundwater in the United States. United States Geological Survey (USGS), 2016-5092.

Veolia, 2015a. City of Flint, MI, City Council Public Works Committee: Interim Water Quality Report. February 18, 2015. Veolia.

Veolia, 2015b. Flint Michigan: Water Quality Report. March 12, 2015. Veolia.

Veolia, 2015c. Technical Memorandum: THM Treatment Strategies for Flint, Michigan. March 30, 2015. Veolia. COF\_FED\_0016292-0016321.

Expert Report of Dr. Larry L. Russell  
January 3<sup>rd</sup>, 2023

Veolia 2015d. Flint Spreadsheets: Natively Produced Documents. February 27, 2015. VWNAOS059356-059368.

Veolia 2015e. Response to Invitation to Bid Water Quality Consultant: Proposal No.: 15-573. January 29, 2015. Veolia. VEOLIA 003116-003154. February 12, 2015. Veolia. VEOLIA 006599-006608.

Veolia 2015f. Public Works Workshop: Preliminary Report.

Veolia, 2015g. Proposal for Water Quality Implementation Assistance. March 25, 2015. VWNAOS324151-VWNAOS324176.

VNA Exhibit 760, 2022. Case No. 5:17-cv-10164-JEL-KGA.

VNA Exhibit 2938B (Native Excel Spreadsheet), 2022. Case No. 5:17-cv-10164-JEL-KGA.

VNA Exhibit 2938C (Native Excel Spreadsheet), 2022. Case No. 5:17-cv-10164-JEL-KGA.

VNA Exhibit 2938D (Native Excel Spreadsheet), 2022. Case No. 5:17-cv-10164-JEL-KGA.

VNA Exhibit 2938E (Native Excel Spreadsheet), Case No. 5:17-cv-10164-JEL-KGA.

VNA Exhibit 2938F (Native Excel Spreadsheet), Case No. 5:17-cv-10164-JEL-KGA.

VNA Exhibit 2938G (Native Excel Spreadsheet), Case No. 5:17-cv-10164-JEL-KGA.

VNA Exhibit 3127, Case No. 5:17-cv-10164-JEL-KGA.

VNA Exhibit 3164, Case No. 5:17-cv-10164-JEL-KGA.

VNA Exhibit 3165A (Native Excel Spreadsheet), Case No. 5:17-cv-10164-JEL-KGA.

VNA Exhibit 3201, Case No. 5:17-cv-10164-JEL-KGA.

VNA Exhibit 3229, Case No. 5:17-cv-10164-JEL-KGA.

VNA Exhibit 5454D (Native Excel Spreadsheet), Case No. 5:17-cv-10164-JEL-KGA.

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VNA Exhibit 5454E (Native Excel Spreadsheet), Case No. 5:17-cv-10164-JEL-KGA.

VNA Exhibit 5454H (Native Excel Spreadsheet), Case No. 5:17-cv-10164-JEL-KGA.

Wang, Y., G. Zhu and Z. Yang, 2019. Analysis of Water Quality Characteristics for Water Distribution Systems. Journal of Water Reuse and Desalinization, 09.2, 2019, 152-162.

Williams, D.J., C.J. Parrett, W.R. Schock, C. Muhlen, P. Donnelly, D. Lytle, 2018. Design and Testing of USEPA's Flint Pipe Rig for Corrosion Control Evaluation. Journal AWWA, October 2018, 110:10.

Zahran, S., et al., 2018. Assessment of Legionnaires' Disease Outbreak in Flint Michigan. PNAS, February 5, 2018, E1730-E1739.

Zhu, N., and S. Roy, 2015. The Unintended Consequences of Migrating to Flint River Water. Flintwaterstudy.org. August 23, 2015.

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## 11 Depositions and Court Appearances

### **Expert Fees for Dr. Larry L. Russell, P.E.**

**Consulting \$595/hr**

**Deposition \$900/hr**

**Court Appearances \$900/hr**

### **Depositions and court appearances of Dr. Larry L. Russell, P.E.**

Flint Water cases, No. 5:16-cv-10444;5:17-cv-10164, United States District Court Eastern District of Michigan (Ann Arbor), December 2022

LAUSD vs Atlas Metals, Central District Federal Court, Los Angeles, March 2022

Mosaica TNDC vs. James E. Roberts-Obayashi Corporation, Superior Court of San Francisco, December 2021

Mosaica HOA vs. James E. Roberts-Obayashi Corporation, Superior Court of San Francisco, March 2021

Flint Water Cases, No. 46-cv-1044, Federal Court Ann Arbor MI October 2020

Infinity HOA vs. 300 Spear Realty, Superior Court of San Francisco, May 2020

Armstrong HOA vs. Armstrong Development, San Francisco Superior Court, August 2019

Riverwatch vs. the City of Vacaville, Northern District Federal Court, November 2018

Bosen vs Kelly, Los Angeles Superior Court, August 2018

Bosen vs Kelly, Los Angeles Superior Court, July 2018

Cabins at Crooked Pines Owners Association vs South Minaret Development Company LLC

Superior Court Mono County - January 2018

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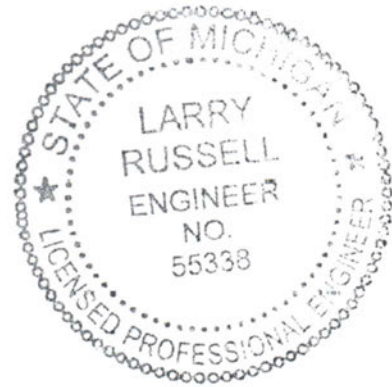
## 12 Signature and Stamp

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and recollection.

Executed this 3<sup>rd</sup> day of January, 2023, in Tiburon CA.

By:

  
Larry L. Russell, Ph.D., P.E.



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January 3<sup>rd</sup>, 2023

## 13 Standard Fees and Conditions

## REED CORPORATION

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200 Martinique Ave  
Tiburon, CA 94920  
(510) 549-2427  
Fax (510)-232-3796

### **RUSSELL ENVIRONMENTAL ENGINEERING AND DEVELOPMENT (REED) INTERNATIONAL LTD. REED INTERNATIONAL LTD.**

#### **2023 STANDARD FEES AND CONDITIONS**

The following fee structure will be utilized throughout the calendar year of 2023. No changes will be made in hourly rates without notification in advance of such changes.

<b>Title Rate,</b>	<b>\$/hr</b>
<b>Principal</b>	<b>595</b>
<b>Senior Associate</b>	<b>395</b>
<b>Associate</b>	<b>295</b>
<b>Geologist</b>	<b>255</b>
<b>Hydrogeologist</b>	<b>275</b>
<b>Technician</b>	<b>175</b>
<b>Drafter</b>	<b>175</b>
<b>Word Processor</b>	<b>150</b>

**Depositions and other related court room appearances will be billed at \$900 per hour for Principal and \$600 per hour for Sr. Associates.**

Other charges such as travel, equipment rental, and subsistence will be charged at cost.  
Company vehicles used on the project may be charged at \$110 per day

Invoices are due on presentation. Interest will accrue from the date of the billing at the highest rate allowed by law and will be added to the invoice after 30 days. All invoices will be considered final and payable in full upon receipt. Any questions regarding the invoices should be addressed to REED within 10 days of receipt.

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## 14 Attachments: Codes of Ethics

# Code *of* Ethics

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THE AMERICAN SOCIETY OF CIVIL ENGINEERS



# PREAMBLE

Members of The American Society of Civil Engineers conduct themselves with integrity and professionalism, and above all else protect and advance the health, safety, and welfare of the public through the practice of Civil Engineering.

Engineers govern their professional careers on the following fundamental principles:

- create safe, resilient, and sustainable infrastructure;
  - treat all persons with respect, dignity, and fairness in a manner that fosters equitable participation without regard to personal identity;
  - consider the current and anticipated needs of society; and
  - utilize their knowledge and skills to enhance the quality of life for humanity.
- c. express professional opinions truthfully and only when founded on adequate knowledge and honest conviction;
  - d. have zero tolerance for bribery, fraud, and corruption in all forms, and report violations to the proper authorities;
  - e. endeavor to be of service in civic affairs;
  - f. treat all persons with respect, dignity, and fairness, and reject all forms of discrimination and harassment;
  - g. acknowledge the diverse historical, social, and cultural needs of the community, and incorporate these considerations in their work;
  - h. consider the capabilities, limitations, and implications of current and emerging technologies when part of their work; and
  - i. report misconduct to the appropriate authorities where necessary to protect the health, safety, and welfare of the public.

All members of The American Society of Civil Engineers, regardless of their membership grade or job description, commit to all of the following ethical responsibilities. In the case of a conflict between ethical responsibilities, the five stakeholders are listed in the order of priority. There is no priority of responsibilities within a given stakeholder group with the exception that 1a. takes precedence over all other responsibilities.<sup>1</sup>

## CODE OF ETHICS

### 1. SOCIETY

Engineers:

- a. first and foremost, protect the health, safety, and welfare of the public;
- b. enhance the quality of life for humanity;

### 2. NATURAL AND BUILT ENVIRONMENT

Engineers:

- a. adhere to the principles of sustainable development;
- b. consider and balance societal, environmental, and economic impacts, along with opportunities for improvement, in their work;
- c. mitigate adverse societal, environmental, and economic effects; and
- d. use resources wisely while minimizing resource depletion.

---

<sup>1</sup> This Code does not establish a standard of care, nor should it be interpreted as such.

### 3. PROFESSION

#### Engineers:

- a. uphold the honor, integrity, and dignity of the profession;
- b. practice engineering in compliance with all legal requirements in the jurisdiction of practice;
- c. represent their professional qualifications and experience truthfully;
- d. reject practices of unfair competition;
- e. promote mentorship and knowledge-sharing equitably with current and future engineers;
- f. educate the public on the role of civil engineering in society; and
- g. continue professional development to enhance their technical and non-technical competencies.

### 4. CLIENTS AND EMPLOYERS

#### Engineers:

- a. act as faithful agents of their clients and employers with integrity and professionalism;
- b. make clear to clients and employers any real, potential, or perceived conflicts of interest;
- c. communicate in a timely manner to clients and employers any risks and limitations related to their work;
- d. present clearly and promptly the consequences to clients and employers if their engineering judgment is overruled where health, safety, and welfare of the public may be endangered;

- e. keep clients' and employers' identified proprietary information confidential;
- f. perform services only in areas of their competence; and
- g. approve, sign, or seal only work products that have been prepared or reviewed by them or under their responsible charge.

### 5. PEERS

#### Engineers:

- a. only take credit for professional work they have personally completed;
- b. provide attribution for the work of others;
- c. foster health and safety in the workplace;
- d. promote and exhibit inclusive, equitable, and ethical behavior in all engagements with colleagues;
- e. act with honesty and fairness on collaborative work efforts;
- f. encourage and enable the education and development of other engineers and prospective members of the profession;
- g. supervise equitably and respectfully;
- h. comment only in a professional manner on the work, professional reputation, and personal character of other engineers; and
- i. report violations of the Code of Ethics to the American Society of Civil Engineers.